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ELECTRICITY IN THE MODERN SHIPYARD.

On other pages of this issue will be found an illustrated description of the magnificent plant of the Fore River Ship and Engine Company at Quincy, Mass. This shipyard presents one of the finest examples of electrical-power distribution that has yet been erected. Throughout the whole of its large extent motive power is applied to a great variety of tools and machines by means of electric power generated at a conveniently placed central station. Indeed, of the various activities which go to make up the complex industrial unit known as a shipyard, all in this case are more or less dependent upon electric power.

The economies resulting are extraordinary. From the very nature of the work carried on in the building of vessels the various operations of making a hull and its interior fittings, of building engines and auxiliaries, of constructing the carpenter and joiner work, the decorations and fittings of a ship, are scattered over a considerable area. To operate the various shops and tools necessary to this work by steam engines directly would require the installation in the yard under consideration of at least thirty or forty engine plants with their accompanying boilers. The saving in the one item of supervision of these plants runs into a large annual total. But more than this, the high power-efficiency realized by centralizing power generation enables the work of the yard to be done with the utmost economy of power, and with beautiful simplicity and ease. A further advantage is obtained in the flexibility of power which is attained by the use of the electric motor—an appliance which can be put on the wall or the ceiling, made part of a tool, or attached directly to it in the most convenient way. Without entering into any discussion of the ship-building industry it may safely be said that no yard equipped with the older appliances ought to be able to compete with one in which the high efficiency of application attained in this instance is shown.

CONDUITS IN CITIES.

It is expected that this summer will see the installation of conduit systems in a large number of cities wherein wires have hitherto been maintained overhead. Throughout the country there has been a general movement on the part of municipal authorities to compel the placing of wires underground, and to the decrees of city councils and the like electrical companies of various sorts must of necessity bow.

The installation of such conduit systems presents the opportunity for making a mistake which has not infrequently been made in the systems already laid down, and which largely parallels the experience of telephone companies in putting up their cable systems and lines. The cost of conduit construction is great. Companies necessarily hesitate at increasing the investment for underground work further than seems immediately necessary. The consequence of this false economy has been again and again that conduit systems have had to be opened and enlarged, always at a great cost for replacing the street surface and for the necessary preparation work.

The point upon which it seems wise to insist is that conduit systems laid down now should be large enough to take care not only of such extensions as are immediately apparent, but also of those that the future is practically certain to bring in any progressive city. The demand for telephone lines is constantly increasing, and any plan contemplating an extension of less than one hundred per cent on telephone conduits will soon be found entirely inadequate. The same is true, to a less degree perhaps, of electric lighting conduits, while there always remains in any case the chance that new developments will require the installation of new lines of conductors of some sort perhaps not now even considered, and these of course will require room in the permanent underground constructions. Since the depreciation on conduits is small an increased investment in them represents practically only an expense equivalent to the interest charge upon the money required.

The wisdom of joint conduits for the occupancy of telephone and telegraph and other light current wires on the one hand, and electric light and power wires on the other, has formed the subject of no little discussion. The trend of opinion seems to be that there is nothing particularly dangerous in maintaining such conductors in the same conduits, provided the cables are brought out to separate manholes.

The danger seems to lurk in the manhole in which heavy current and light current wires are placed together, and in which the employés of telephone companies, familiar only with the small current circuits used in that art, have to come in contact with wires carrying high voltages and heavy currents. If this precaution is taken and the manholes are separated, the cost of a conduit system can generally be reduced considerably, as the excavation of streets and replacing of the surface may be done once for all for each system.

The same remarks apply to taps into blocks or buildings from these systems. It should be the endeavor of those who are planning subways to put down sufficient material to obviate the necessity of again opening the streets for as long a time as possible. In most American cities, especially in the business parts, the blocks are solidly built and contain an open space in the centre into which the rear premises on all four sides of the square abut. Service connections from the conduits should always, if possible, be taken into these interiors of blocks, where wires may radiate from a pole conveniently placed into the rear extensions of the buildings, thus obviating the necessity for separate services for each building or group of buildings.

Those companies which practise the apparent economy of putting down only such conduit material as is necessary for the immediate conduct of their business will soon find themselves in difficulties and antagonized by municipal authorities and property-holders on account of the frequent opening of streets necessary to the enlargement of their systems.

MAIN-LINE ELECTRIC TRACTION.

Of all the various problems that confront electrical engineers perhaps the most interesting and confusing is that of the application of electricity to main-line railroads, such as are now operated by steam. It has been, perhaps, too generally assumed that the successful operation of street railway cars by electricity has shown the way to the suppression of the locomotive and the installation of electrical service on all of our railways. There is no doubt that at present electrical appliances may be made which would replace the locomotive with advantage in certain directions, but the question of electric traction for railroads is one that includes many phases and involves considerations of a highly complex and almost multitudinous character.

The railroad of to-day is an evolution from the post road and the stage coach. Early in the last century it was found that the increasingly heavy traffic of certain English coal mines made the maintenance of ordinary road surfaces practically impossible. As a consequence the tramroad was invented, and iron rails were laid down, upon which the wheels of the coal wagons moved between the mines and wharves, where the fuel was loaded into vessels. The motive power was still the horse or the mule. To apply the steam engine, then rapidly being developed for stationary purposes, to this variety of road, was the next step and the success of the application inaugurated railroads as we now know them. From this humble beginning there has developed the railroad of to-day, differing in each country of the world and even from section to section of the different states in its type and character, though largely standardized as regards gauge and the character of its motive-power equipment. The business of a railroad involves the transportation of passengers and freight, and in each of these great divisions there is a large number of classes. For example, the considerations governing the successful and economical handling of heavy freights, such as coal and ore, do not apply to the transportation of light freights which must be moved rapidly, such as mail, express and perishable goods. Passenger service is divided into many classes, of which the extremes may be considered as high-speed, long-distance, so-called express service, and local or suburban transportation involving the use of trains making many and frequent stops and running at moderate speeds for short distances. The growth of railroads has involved the solution of difficult problems of termini, and of the swift and expeditious handling both of goods and passengers under a bewildering variety of circumstances. The complexity of the question involved is sufficient to give pause even to the most ardent inventor who produces a method which he claims to be satisfactory for all railway purposes.

The development of the steam locomotive has been astonishingly successful and these machines, although of acknowledged inefficiency as regards their consumption of fuel, are fairly satisfactory for the purpose for which they are designed and represent the crystallized experience of many years of use and experiment. In order properly to consider the question of electric traction, the first necessity is to examine the economical factors entering into the case, and to see in what direction improvements in the earning power of railroads may be made. For it is certain that no changes will be made which do not involve additional earning power, and no investment will be put down for which a satisfactory return can not be fully foreseen.

Putting aside as at present impracticable any system using storage batteries or their analogues, the various conducting systems may be considered and the two classes of current, direct and alternating, looked at with reference to their availability for the immediate purpose. Conducting systems may be divided roughly into two classes, those which use the track as one part of the conducting system, and those which do not. In the former case it is necessary to make the track electrically continuous, which can be accomplished only by bonding the ends of rails together or by welding them together, which is not regarded as a possible practice under the conditions which surround the ordinary railway road-bed. The conductors may be placed either overhead or at one side of the track, or on or near the ground level, and may be one, two or three in number, according to whether direct or single-phase current is used, whether polyphase current is utilized, and whether or not the track is made part of the conducting system.

Whatever method is adopted, it is obvious that it should be such as to be equally useful in crowded station yards and termini and on the comparatively free right of way in country districts. The third rail or ground-level method of

conduction has met with a certain vogue in situations where an absolutely private right of way is possible, thus eliminating all danger of the contact of individuals with live conductors. In other situations it is manifestly so dangerous as to be out of the question. Mechanically, the third-rail system has obvious advantages, and in order to make use of these no less than four hundred sectional third rail or closed systems of conduits have been invented and patented in the United States Patent Office alone. Of this great number probably none is to-day in successful commercial operation. On elevated railroads, and in situations where ample restrictions guard the right of way, third rails have been put down and operated with great success, as notably is the case upon the elevated railroads in various American and European cities, the tunnel roads in London, and a few suburban railways such as that at Hudson, N. Y. But the third rail is evidently not the solution for the conductor problem. In order to get the working conductor out of the way and in a safe place, and in order further to promote the use of high voltages upon it, it seems necessary to put it above the track in some way, and thus to use the overhead system.

The energy necessary to deliver to a train of considerable size moving at a high rate of speed is so large as to make the use of the trolley wire or its equivalent practically out of the question, unless enormous voltages, themselves introducing serious difficulties, are utilized. We may look forward, then, with some degree of confidence to seeing overhead systems of considerable size and rigidity employed, and very probably upon them the highest voltages that can safely be insulated. Assuming then that the overhead method will be employed and that high voltages will be used, what voltage and current seem best adapted to meet the various exigencies of the situation?

The direct-current motor possesses the ability to develop an enormous starting effort, and to accelerate the load connected with it rapidly up to full working load. The polyphase motor does not exhibit so large a starting effort, but has other very great advantages, notably in its mechanical construction and in its ability to be made for voltages utterly impossible for direct-current machinery. The latter is limited by considerations of commutation, in the present state of the art, to about one thousand volts or less, while induction motors may be made satisfactory to operate upon much higher electrical pressures. The question of pressure or voltage is intimately connected with the economy of operation, since the doubling of the voltage employed results in the reduction to one-quarter of the necessary amount of conducting metals to be put down in the permanent conducting system. For this reason most engineers who have considered the railway problem have looked to the use of polyphase motors in some form as its solution.

But the operation of polyphase motors for this purpose involves difficulties of no small degree. The control of such apparatus is not by any means as perfect as might be desired, and their small starting effort seriously militates against the rapid acceleration necessary in local passenger service, or wherever frequent stops are made and a high-speed schedule is desirable. The direct-current motor as developed in street-railway practice is one of the most entirely satisfactory machines that has ever been devised, but the necessary limitations of voltage under which it labors would require, in the case of train units as at present operated, the collection of enormous currents from the fixed conducting system, and would entail consequently unusual difficulties, which have not yet been solved. In addition to this, the advantages peculiar to an alternating-current system where the highest permissible voltages may be used for distribution, and these pressures reduced by transformers at suitable points for the working conductor, are entirely lacking in the direct-current system unless recourse is had to substations involving converting machinery. Up to now no such mechanism has been made that does not involve moving parts, and consequently continuous attention on the part of skilled employés. It is not believed that the substation system, employing converters, affords a genuinely practicable and satisfactory solution of the railway problem on account of the necessarily high installation and maintenance cost involved.

The whole subject may then be summed up in this way: All the various classes of railway service, as railways are operated at present, may each be worked electrically with success and satisfaction, but likely each will require a different variety of installation. To lay down upon any railway right of way an electrical installation entirely satisfactory for the operation of all classes of traffic will probably require a revolution in railway methods. If we can assume that freight and passengers are to be moved from terminus to terminus, but that the conditions under which they are to move—that is, the formation of trains—may be taken also as one of the variable quantities of the problem, then a host of new solutions opens before the investigator and the problem becomes less difficult and at the same time curiously more complex. Instead of a long train of many cars transporting many passengers, and sent out at infrequent intervals from stations, we can conceive the small train of one or two cars, carrying fewer passengers, running more swiftly, and leaving stations more frequently, a condition almost ideal for electrical operation. In the case of freight, two extremes seem to present themselves for consideration; either the train must be long and heavy and hauled by powerful locomotives at slow speeds, or, as in the case of passenger trains, the trains must be subdivided into smaller units and despatched more frequently.

From the above hasty review of the engineering limitations surrounding railway equipment it may be seen that the art is not yet far enough advanced to warrant any very definite predictions. The question of economy, which is the primary question after all, is so modified by the necessary introduction of unknown conditions, themselves imposed by electrical equipment, that its consideration becomes difficult, and perhaps even impossible without further experimental data than is now at hand. While we may have faith in the eventual electrical equipment of steam railways, still it may be said to-day that the method is not obvious, and that no prophet has arisen to show us the way.

EFFECT OF VARIATION OF FIELD ON POWER AND SPEED OF A CONSTANT POTENTIAL MOTOR.

BY B. T. McCORMICK.

It is a well-known fact that the force upon a wire is proportional to the current flowing in it, and the strength of the field in which it lies. For this reason it seems, at first, absurd to say that the speed of a motor will increase when the field is weakened. The following article, it is hoped, may serve to explain the apparent paradox.

Let T = torque of shafting, supposed constant.
Let V = constant electro-motive force of supply.
Let n = speed in revolutions per second.
Let C = number of armature conductors in series.
Let N = total magnetic flux.
Let I = armature current.
Let E = back electro-motive force of motor.
Let R = resistance of armature.
Let P = power.

The above quantities we will suppose to be in centimetre-gramme-second units in order to do away with the introduction of numerical constants which would otherwise come in later.

The power of a motor can be electrically expressed as the product of the armature current and the back electro-motive force generated, or it can be expressed mechanically as the product of torque and angular velocity. Equating these expressions gives—

$$2\pi n T = EI \qquad (1)$$

But the back electro-motive force generated by the motor is given by the formula—

$$E = n CN \qquad (2)$$

which when substituted above gives—

$$2\pi n T = n CNI$$

$$T = \frac{CNI}{2\pi} \qquad (3)$$

but—

$$I = \frac{V-E}{R} \qquad (4)$$

So equation (3) becomes—

$$T = \frac{CNI}{2\pi} = \frac{CN}{2\pi}\left(\frac{V-E}{R}\right) = \frac{CN}{2\pi}\left(\frac{V-n\ CN}{R}\right) \qquad (5)$$

Solving for speed, n, gives—

$$n = \frac{V}{CN} - \frac{2\pi TR}{C^2N^2} \qquad (6)$$

Now if the torque or moment required to turn the machinery, remains constant no matter how the speed varies, we see that if R is small and C large, which is always the case, the speed and therefore the power exerted will increase as we decrease N.

Considering the change of power from the electrical standpoint, it is evident that if our last statement is correct then EI will be increased by a decrease of field.

Substituting the value of n given in equation (6) in equation (2) gives—

$$E = \left\{\frac{V}{CN} - \frac{2\pi TR}{C^2N^2}\right\} CN = V - \frac{2\pi TR}{CN} \qquad (7)$$

So a decrease in N means a decrease in E. To get the effect on I, we have—

$$I = \frac{V-E}{R} = \frac{\left(V - \frac{2\pi TR}{CN}\right)}{R} = \frac{2\pi T}{CN} \qquad (8)$$

which shows that a reduction of field increases the current. It now remains to be seen whether the increase in current is sufficient to overbalance the falling off in E, *i. e.*, whether the power EI will become greater when the field is weakened.

$$P = EI = \left(V - \frac{2\pi TR}{CN}\right)\frac{2\pi T}{CN} = \frac{2V\pi T}{CN} - \frac{4\pi^2T^2R}{C^2N^2} \qquad (9)$$

An investigation for the conditions of maxima and minima, by the calculus, will show the behavior of P when the field strength is varied. Dividing the right-hand member by $\frac{2\pi T}{C}$, which is perfectly legitimate, as long as we are not dividing by a variable, gives—

$$\frac{V}{N} - \frac{2\pi TR}{CN^2} \qquad (10)$$

Differentiating with respect to N and equating to zero—

$$-\frac{V}{N^2} + \frac{4\pi TR}{CN^3} = 0 \qquad (11)$$

$$N = \frac{4\pi TR}{VC} \qquad (12)$$

In order to ascertain whether this value of N gives a maximum or minimum value to the power, we must differentiate equation (11) and substitute this value for N.

$$\frac{2V}{N^3} - \frac{1}{N^4}\frac{16\pi TR}{C}$$

Substituting the value of N given in equation (12) gives—

$$\frac{2V^4C^3}{64\pi^3T^3R^3} - \frac{V^4C^3}{16\pi^3T^3R^3} = -\frac{V^4C^3}{32\pi^3T^3R}$$

The minus sign shows that the value $N = \frac{4\pi TR}{VC}$ makes the power a maximum.

The accuracy of this value for maximum power is somewhat questionable on account of the demagnetizing effect of the armature current, but it is, however, sufficiently accurate to show that the maximum power and speed occur when the field is very weak, for R is always very small and C very large.

We thus see that as our field is made weaker and weaker so as to approach the value given in equation (12), the power and speed become greater and greater, but a further reduction past this value causes the power and speed to fall off again. In practice it often happens that the field never becomes so low as to pass this value for maximum speed. If the field current is broken entirely, enough residual magnetism remains to cause the motor to "run away."

The foregoing treatment shows that a given decrease in N increases the current by a greater per cent than it decreases E. This is obvious from equations (8) and (9). So much for the analytic explanation.

From the physical standpoint we may reason as follows: The field is decreased, say to one-half its original value; the armature, still revolving at the same speed, generates only one-half the counter electro-motive force it did originally. This causes the current to rise to several times its former value, especially if V and E were originally very nearly equal. This large current of several times the original value acts with the field, which has only been reduced by one-half, to produce a torque much greater than that of the shafting. This inequality of torques causes the armature to accelerate its motion till the back electro-motive force has increased enough to make I of such a value that the torques are again equal; the armature then revolves at uniform speed once more, but much faster than before.

In view of what has been said, the question naturally arises, why not use a weak field and get a greater power and speed? The efficiency of a motor is given by the expression—

$$\frac{E}{V}$$

and since we decrease E when we weaken the field we also lower the efficiency.

Two years ago the German Colonial Society offered a prize of 3,000 marks ($714) for the finding of a plant in the German colonies furnishing gutta-percha suitable for cable purposes. A telegram, writes Consul-General Guenther, from Frankfort, from German New Guinea says that gutta-percha, as well as rubber, has been found in large quantities.

The Electrical Equipment of a Modern Shipyard.

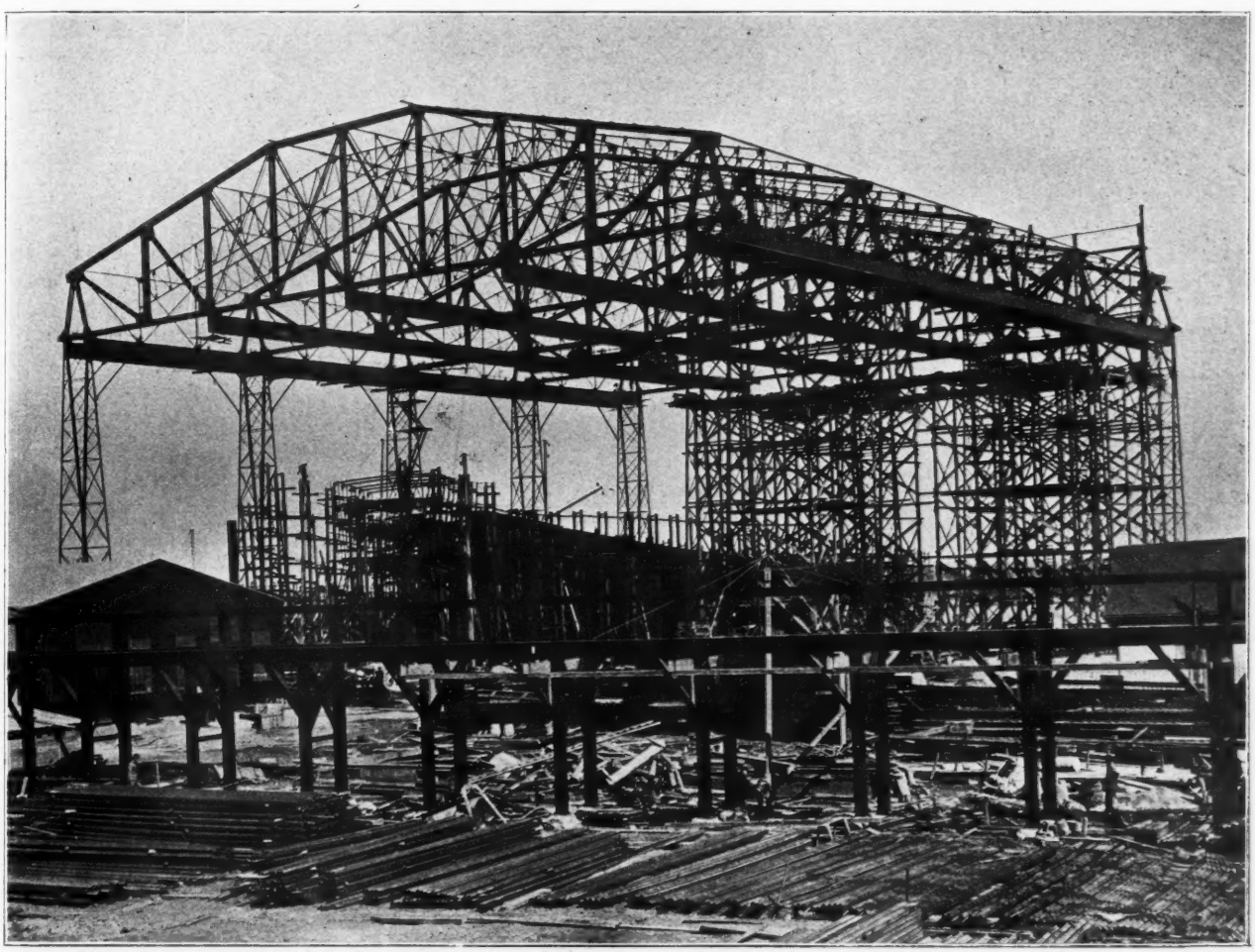
Electrical Power Distribution and Application in the Ship-Building Plant of the Fore River Ship and Engine Company at Quincy, Mass.

ONE OF THE finest and most completely equipped shipyards that has recently been erected on our Atlantic coast is that of the Fore River Ship and Engine Company, at Quincy, Mass., a suburb of Boston. The plant occupies seventy-eight acres of land, lying along the Weymouth Fore River, upon which the grounds have a frontage of one and three-quarter miles. Upon this area there are fourteen large buildings and a considerable number of smaller ones, enclosing a floor area of nearly eleven acres, and comprising all of the multitudinous industries which are necessary in the construction of modern vessels, both ships of war and of the merchant class.

Outside of the unusual completeness of its plant, the most interesting feature of this yard is the fact that electrical-power distribution is used throughout, power being generated in a central station, and that every tool used, with the exception of pneumatic ship tools, steam hammers and a few hydraulic presses, is electrically operated.

Referring to the accompanying sketch map of the yard, it will be seen that the principal feature of its arrangement is that the various buildings contributing material to the erection of ships are conveniently placed with reference to the delivery of their product to the great structure known as the ship-house. This at present is 490 feet by 325 feet in plan, and is high enough to permit the great cranes, which it encloses, to travel over any part of a battleship or other large vessel lying on the stocks within. This building is of skeleton construction, as is excellently shown in the accompanying engraving. Indeed, it is not a building at all in the ordinary sense of the term, but is a skeleton steel structure primarily intended to support the cranes running over the ship-work going on below.

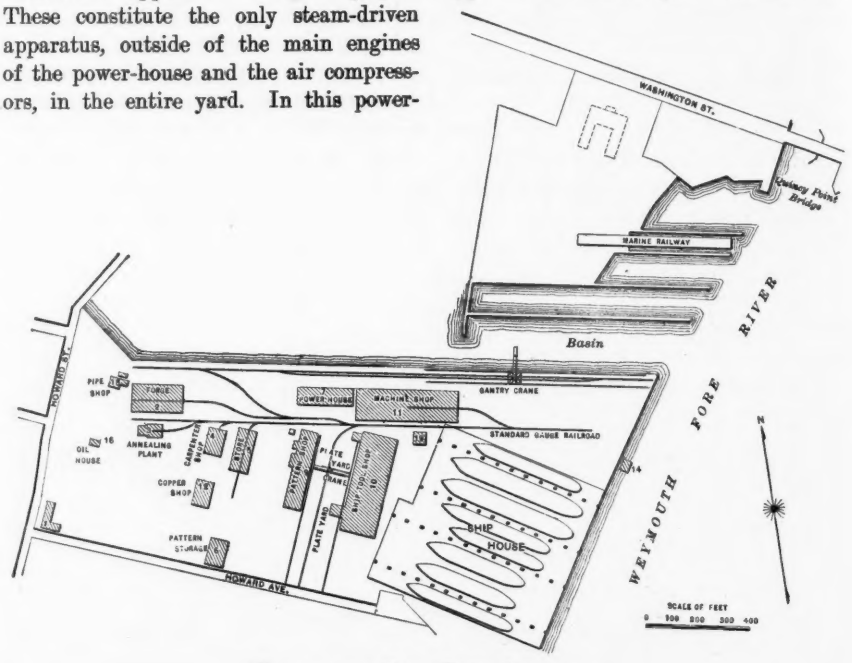
The forge is the third largest in the United States, and the only one attached to a shipyard of sufficient dimensions to turn out the heaviest work in ship-building. Here are forged under steam hammers the immense pieces of steel used for the shafts of heavy war-ships, and also for the various parts of guns used in their armament. Near this forge is an annealing plant wherein the largest pieces may be heated in oil-burning



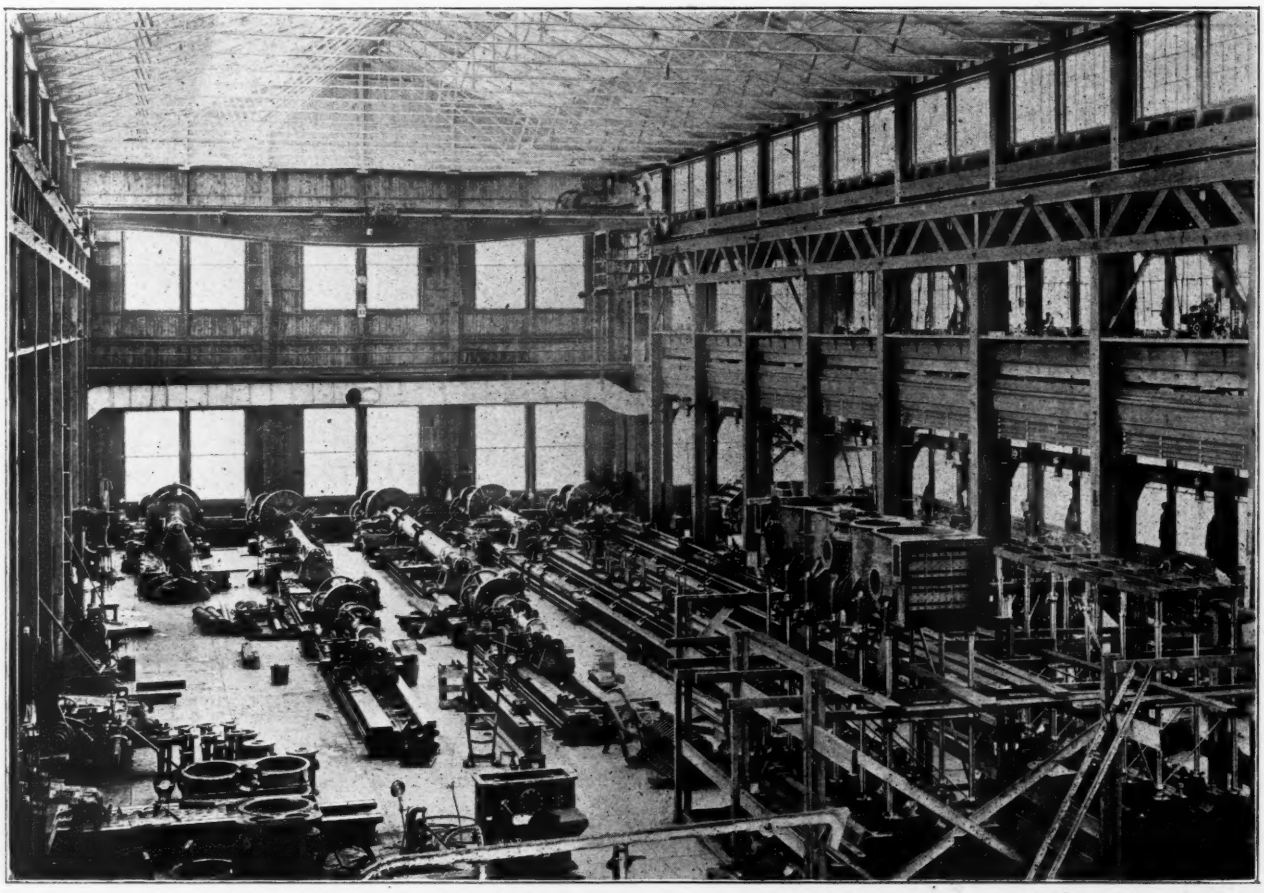
THE "SHIP-HOUSE," A SKELETON STRUCTURE FOR SUPPORTING THE MASSIVE ELECTRIC CRANES RUNNING OVER SHIPS ON THE STOCKS, FORE RIVER SHIPYARDS.

furnaces and annealed in baths of oil contained in immense vertical cylindrical tanks. The machine shop, a very large building, contains tools of the heaviest variety, including lathes of great size and planers that will work up to twelve feet square by thirty feet long.

To proceed now to the description of the electrical equipment, it will be noticed that the power-house occupies a position central with reference to the other buildings of the yard. The building itself is 162 feet by 65 feet in size, and like most of the other buildings of the yard is of slow-burning construction. Here is generated current for about 175 motors, ranging in size from one-half horse-power to 150 horse-power, for 165 arc lamps and about 2,000 incandescent lamps. The apparatus of the power-house is of the simplest construction, as only one variety of current is generated for all classes of service—direct current at 240 volts. The boiler equipment consists of six 6 by 16 feet return tubular boilers, set in brick, and operated at 125 pounds pressure. Coal is received on railway cars alongside of the power-house and hand-firing is used. The chimneys are only high enough to carry the combustion gases above the roof, and an induction system of draft is made use of, the well-known Sturtevant appliances being employed. These constitute the only steam-driven apparatus, outside of the main engines of the power-house and the air compressors, in the entire yard. In this power-house there are two separate plants, one, which may be called the old plant—which is retained for emergency and slack-time service—containing belted units, while the new apparatus is of the direct-coupled type. The smaller plant consists of a 12 by 36-inch Corliss engine, belted to a sixty-five-kilowatt General Electric 240-volt direct-current generator. This en-



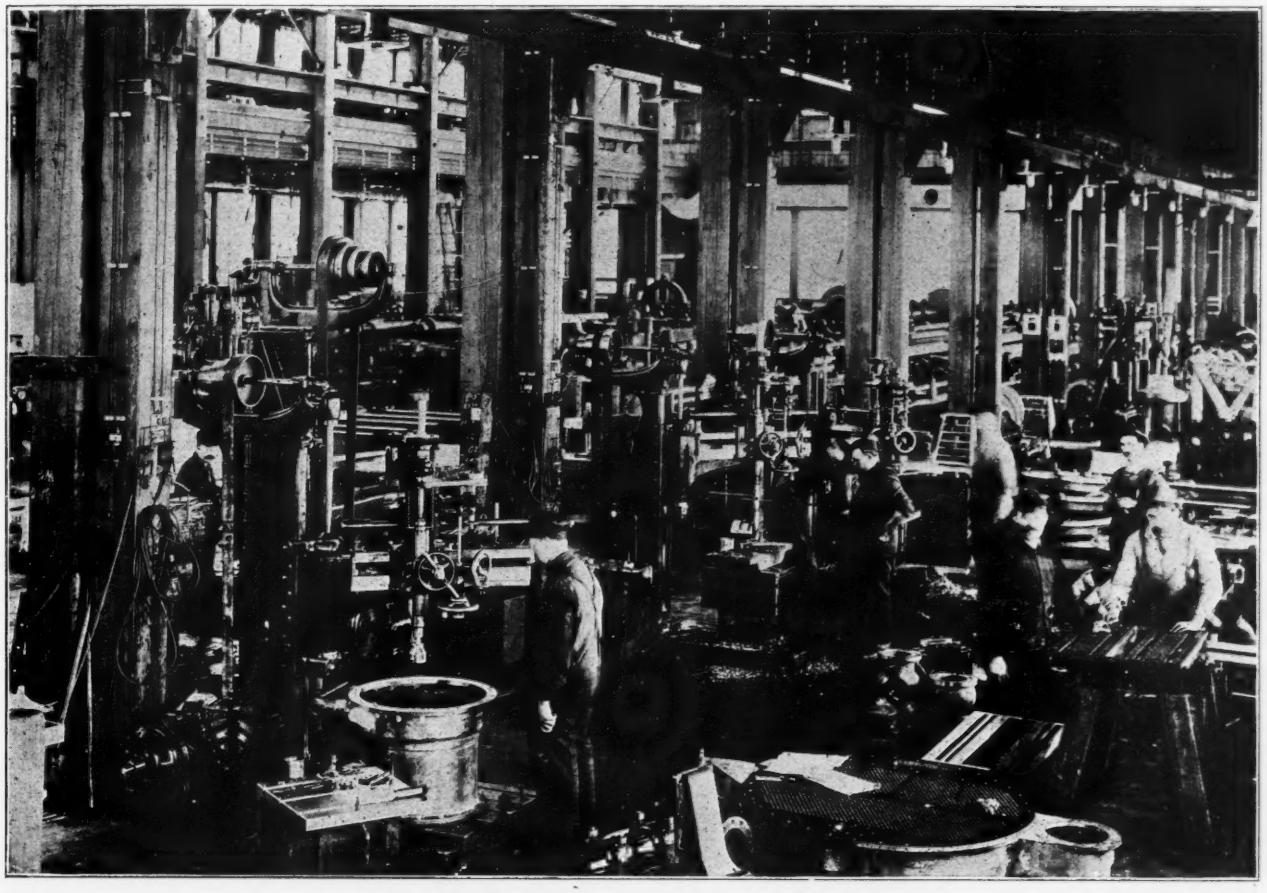
PLAN OF THE FORE RIVER SHIPYARDS



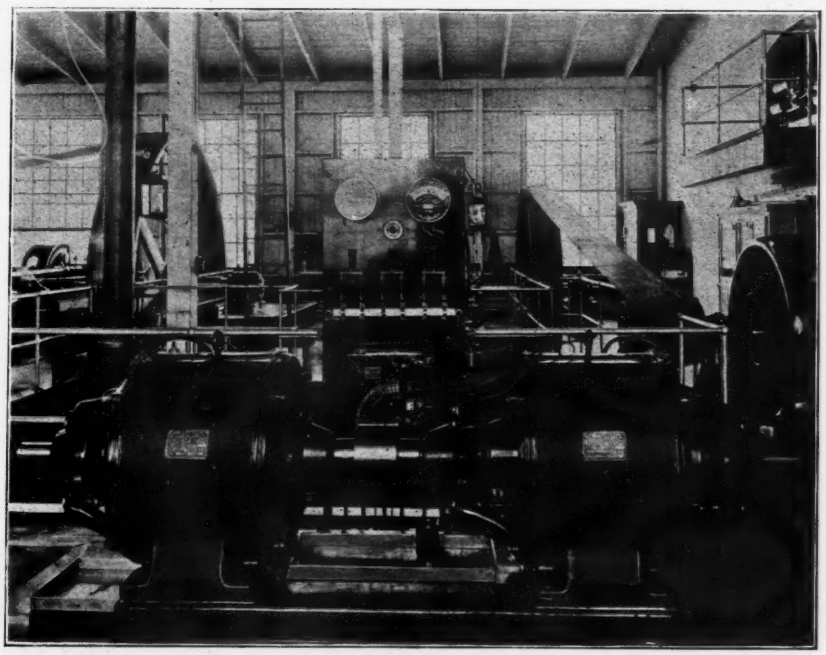
ONE END OF THE MAIN MACHINE SHOP OF THE FORE RIVER SHIP AND ENGINE COMPANY'S YARDS.

gine is interesting as being one of the original Corliss make and still exhibiting high economy and perfect satisfaction in operation. Another unit of the older plant is a 14 by 26 by 36-inch Hamilton-Corliss tandem-compound engine belted to a Bullock generator of the same class and voltage as that described above. These two machines constitute the old plant which is used as a reserve and for working nights and Sundays.

The new generating plant consists of two 300-kilowatt General Electric generators direct-coupled to tandem-compound Hamilton-Corliss engines. Of these one unit is at present installed and operating, while the other is shortly to be put in place. In addition there is a multi-voltage generator, shown in one of the accompanying illustrations, of fifty-horse-power capacity, of which the purpose is more fully explained below.



A Corner in One of the Smaller Machine Shops, Fore River Shipyards.

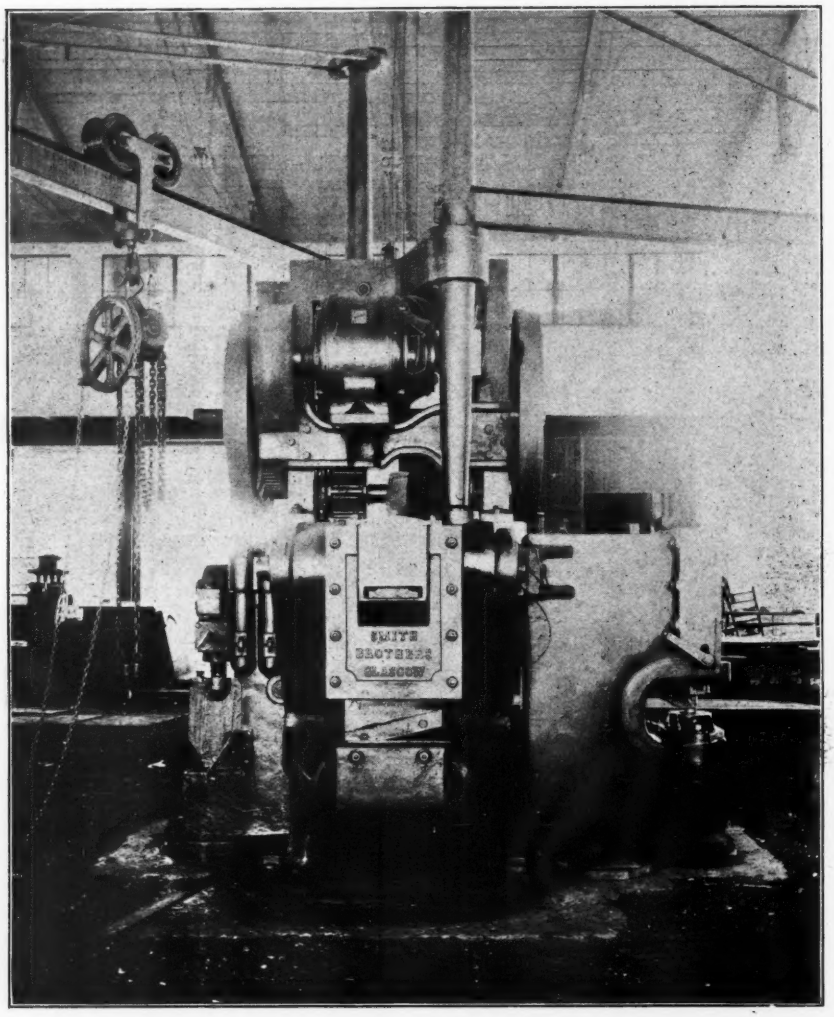


Multiple Voltage Motor Dynamo in the Power-House of the Fore River Shipyards.

In the same power-house building is the fine air-compressing plant needed to supply the large number of pneumatic tools, such as hammers, drills, caulkers, etc., used in ship work. This consists of two machines, one of 1,000 cubic feet and one of 5,000 cubic feet capacity per minute, both of which are operated by cross-compound Hamilton-Corliss engines. The large compressor is of the Rand type, and the small of the Ingersoll-Sargent type. All of the engines in the power-house are operated condensing. Electrical distribution throughout the plant is based upon a 240-volt, two-wire, direct-current system, with some use of the multiple-voltage system for speed variations. The entire motive equipment was supplied by the Bullock Electric Manufacturing Company, of Cincinnati.

The multiple-voltage system is one in which the impressed electro-motive force upon the armature of a motor is changed to meet the requirements of speed regulation. A four-wire system is used in connection with the multiple-voltage motor-generator mentioned above, which enables pressures of 60, 80 and 110 volts to be carried between the various pairs of wires. By proper combinations of these voltages it is readily seen that pressures of 60, 80, 110, 140, 190 and 250 volts may be had, these pressures differing from one another practically in the constant ratio of two to three. By combining with this variation of voltage, which may be impressed upon an armature circuit, a small range of shunt field regulation—the field being constantly fed from the standard 250-volt mains—a range of speeds in which the highest is six and one-half times the lowest, is very readily obtainable. The controllers for such a system are exceedingly simple and compact and may be attached directly to the machine tools themselves, as is very clearly and plainly shown in some of the accompanying engravings.

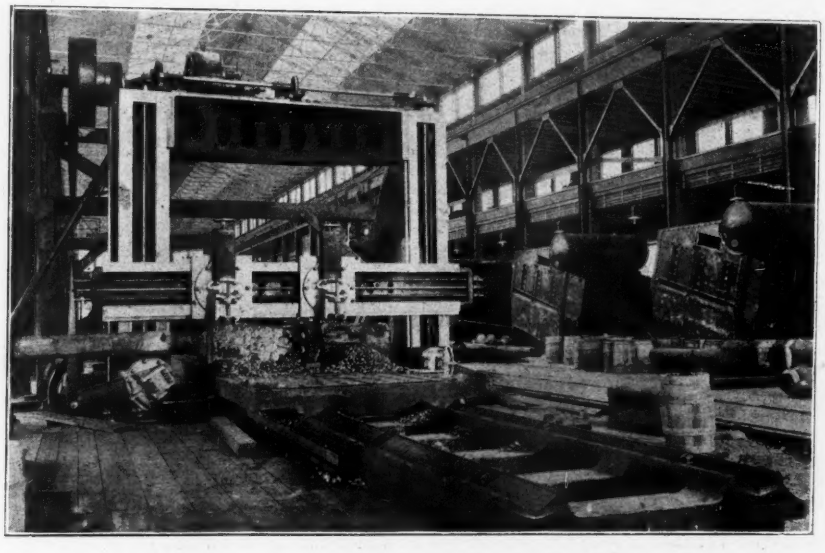
It should be noted that, although the connected load of motors is in the neighborhood of 2,000 horse-power, the average daily load upon the plant is about 1,200 amperes for both power and lighting, or only about 400 horse-power. Of course this varies between considerable limits as the larger tools and cranes are stopped and started, but the figure given is a fair average of the total output of the power-house and forms in itself one of the most telling illustrations of the great advantages to be secured from electrical power distribution and subdivision such as is practised to the fullest extent in this yard.



An Electrically Driven Plate-Shears, Fore River Shipyards.

About seventy-five per cent of the total number of motors are direct-coupled to the tools they operate. Some of the others are belted, and in one or two instances are counter-belted to attain high speed, this practice being almost entirely confined, however, to the wood-working tools, which require a different method of power application. A large number of special motor-driven tools of great ingenuity have been devised for facilitating ship-building operations. One of these is shown in the accompanying illustration and consists of a counter-sinking machine. The machine consists of a motor geared to a drill stock in which is the counter-sinking tool, the whole being mounted on a hand-barrow so that the counter-sink can be pressed down by hand into a punched hole, in a plate for example. By the use of this ingenious machine much time is saved in the operation of counter-sinking plates, the tools being taken to the work rather than the work being taken to the tool as has been so generally practised before.

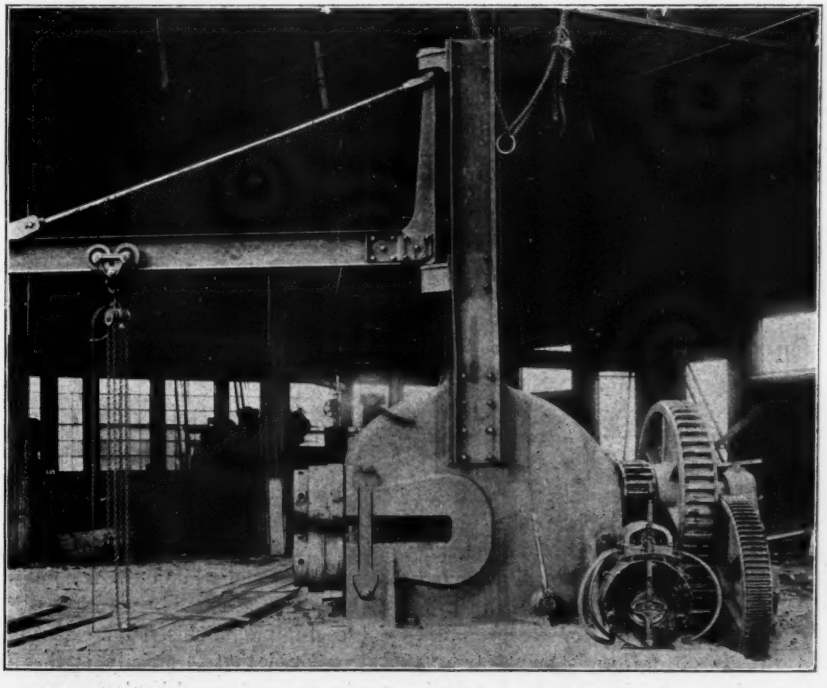
The distributing system between the power-house and the various shops is of great interest. The average centre of distribution in each building is about 500 feet from the power-house switchboard.



One of the Large Motor-Driven Planers, Fore River Shipyards.

In order to connect these centres there has been installed about 1,000 feet of stone masonry subways, large enough for men to walk through and work in, and nearly a mile of pole line. The power lighting circuits are joined upon the bus-bars of the main switchboard. Each shop has its own set of mains coming up through the floor to a distributing board and these feeders are taken off in various directions about the shop to the individual tools. In the ship-tool shop the centre of distribution is placed in an elevated room from which a full view of all the heavy tools may be had. In this shop is handled all of the plate and structural steel material going to make up the "skin and bones" of the ship, and the pieces are heavy, large and often of awkward shapes. To handle them properly requires great care and skill on the part of the men, and little time is left them for the control of individual motors operating the tools. For this reason, in this particular shop, all of the control apparatus for the various tool-driving motors is centered in a gallery in the room referred to, and the tools are worked by one attendant who can see the entire floor and observe the need of any tool from his elevated position. By this method, also, the delicate parts, such as controllers and regulators, are taken away from the machines where they would be liable to injury by contact with the heavy plates and other pieces which are handled at the machines and put in a place of safety. In this shop, as in all the others, there are no exposed wires whatever in the neighborhood of the machines. All the circuits are run under the floor and are brought up in steel conduit to the machines, so that an accidental blow from a hand tool or a crooked piece of work will not interfere with the circuit.

Portable Counter-Sinking Machine, Fore River Shipyards.



"Joggling Machine" for Upsetting Plates, Motor-Driven, Fore River Shipyards.

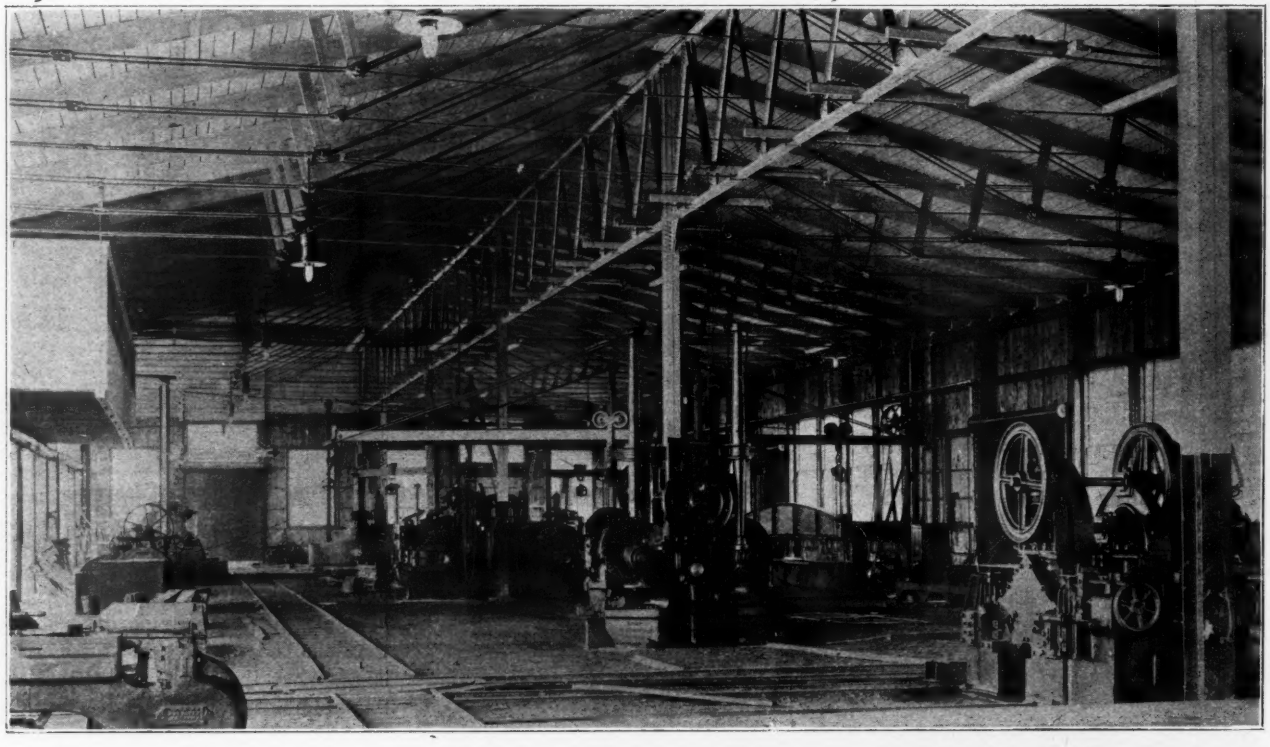
In the subways referred to the circuits are run upon rubber-covered cables, manufactured by the Standard Underground Cable Company, which are simply cleated to wooden strips. This has been found sufficient insulation, considering the low voltage used and the dry and well-ventilated subway in which the mains are laid. When the centre of distribution in the building is reached the line comes up in enameled "electroduct" tubing, in the way shown in one of the illustrations. At this centre of distribution are gathered the main fuses and switches for control of the various tools.

A shipyard is a manufacturing unit of the utmost complexity. It includes work ranging from the forging of steel shafts and the bending of heavy ship plates to the upholstering of cushions and the construction of dish-racks and other small joiner work. At present there are under construction in the Fore River yards two 15,000-ton battleships, the New Jersey and the Rhode Island, the cruiser Des Moines, and two torpedo-boat destroyers, the Macdonough and Lawrence, for the United States Government. There is also on the stocks about to be launched a seven-masted steel schooner of 11,000 tons displacement, which will be the largest sailing vessel in the world when it

is put in commission. It is of great interest to note that in the new battleships mentioned electricity will have played a most important part throughout their construction, while in their operation it is a chief auxiliary. Practically all of the machine work upon these magnificent ships is being done by motor-driven tools, while all of their auxiliary apparatus, with the sole exception of the steam steering-gear, will be motor operated. Each ship will carry a central station generating plant that would be a credit to a fair-sized town.

No mention of the Fore River yards would be complete without reference to the use made in them of electric traveling cranes. In the ship-plate yard, wherein are stored the plates, angles and other shapes which go to make up a steel ship, there is a traveling crane of the Morgan type having a clear span of 150 feet and a run of over 700 feet. This is probably the largest crane of its class in the world. The great machine shop is spanned with another crane, also motor-driven, of extraordinary span and great lifting capacity, and having a run of 400 feet. Many other cranes of various types, also electrically driven, are in use in the various departments of this large industrial establishment. All of these cranes were furnished by the Morgan Engineering Company.

The visitor to the Fore River shipyard is struck with the perfection of design exhibited in the planning and correlation of the various units of the establishment. By the use of motor power throughout a great saving in power cost has been made, while the increase in convenience and speed of operation is almost incredible to those who are not familiar with the advantages to be obtained by motor-driven apparatus for this class of work. The buildings are large, well lighted and well ventilated and the machine tools embody the latest designs in apparatus of their character. They are worked upon what may be called the "intensive" system, each tool being made to put forth its utmost effort, and all this being accomplished principally, if not entirely, by the well designed and thoroughly carried out system of electrical distribution briefly described above.



PORTION OF THE SHIP TOOL SHOP, SHOWING TOOLS USED IN WORKING SHIP FRAMES AND PLATES, FORE RIVER SHIPYARDS.

Professor Tine Tammes describes in the *Zeitschrift für wissenschaftliche Mikroskopie*, xviii, p. 280, a convenient form of electrical lamp for use with the microscope, which has been introduced into the Botanical Laboratory at Groningen. The lamp itself is an incandescent lamp of about 4 cm. diameter, and is enclosed in an iron box, the weight of which adds to its steadiness. This box is open at the front and back, the back opening letting out the heat, while the front opening is furnished with grooves for inserting glass plates. The front plate is of ground glass, specially chosen for its low-absorbing power and absence of coarse grain, and this gives a uniformly bright area as source of illumination. Behind this is a screen of cobalt or other colored glass for absorbing the superfluous yellow rays.—*Nature.*

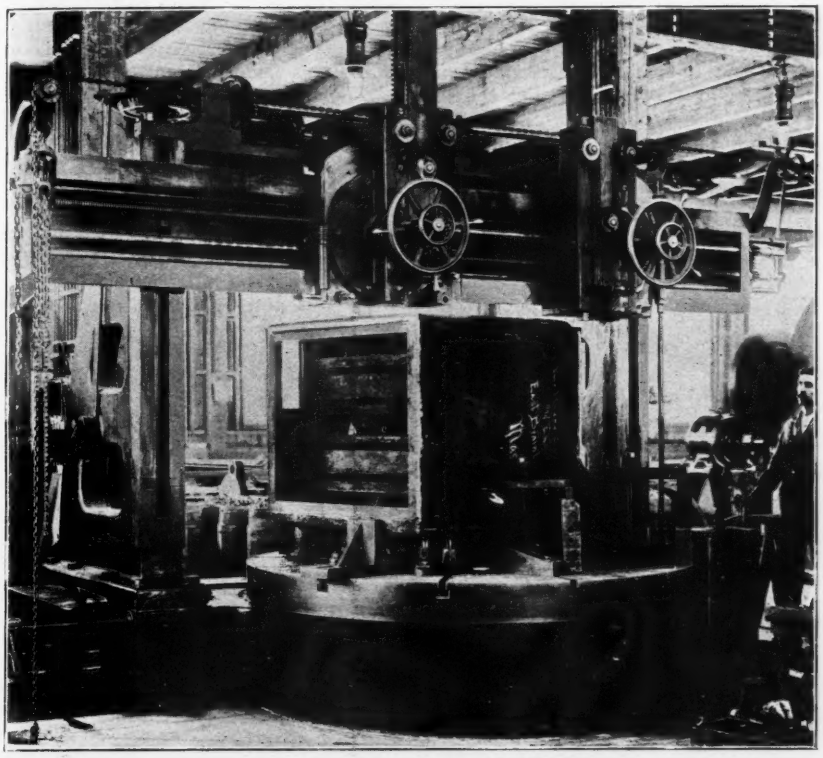
ELECTRICITY IN COAL MINING AND COAL HANDLING.

BY WILLIAM G. IRWIN.

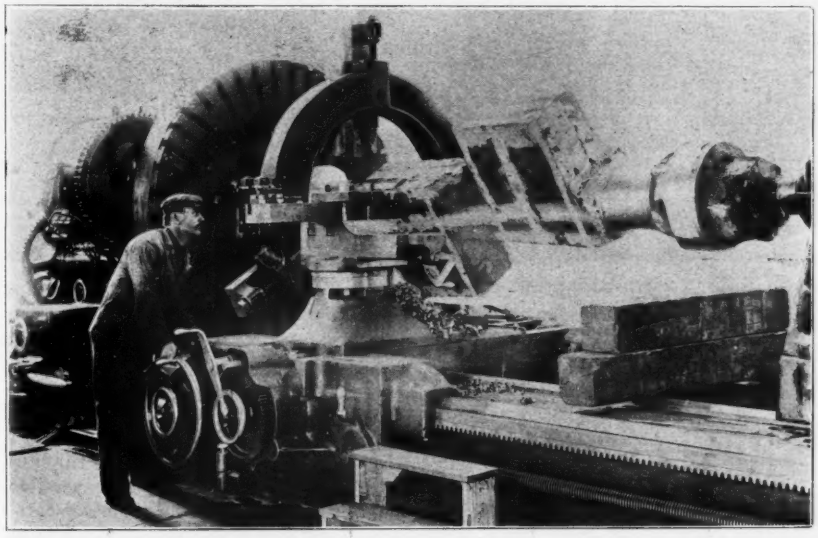
The wonderful activities in the way of introducing new and improved machinery into the various operations of coal mining and coal handling during the past four or five years have marked the beginning of a new era in this important fuel industry, and at the same time similar improvements have attended to coking industry by far the most important of the subsidiary fuel industries. This new departure in improved coal-mining operations had largely been made possible through the application of electricity to the various features of the coal industry. It has not been so long ago since miniature steam locomotives, it was thought, would take the place of the mule in coal haulage. However, this has been found impracticable owing to the steam resulting, and which, it has been found, loosens the roof and causes frequent "cave-ins" in the mines. The next departure in improved mine haulage was with compressed-air locomotives, and while quite a number of these engines are now in use in the different coal-mining fields, later experiments have proven that electricity is the ideal motive power for coal haulage.

While experiments looking to the improvement of the haulage system were going on attention was also being given

to improvements along other lines. The first application of electricity in coal mining consisted of the introduction of electric lighting for the purposes of lighting the main entries. For some time trouble was experienced through explosions resulting from imperfect insulation, but this was soon remedied and electric lighting has been largely used of late years, in many instances the system being extended to the workings. The perfection of electrical coal-cutting machinery opened up another field for electrical power as applied to coal mining. This and other improvements have made it possible to operate a modern coal mine largely through electrical power, and in consequence the modern electrical power plant has come into use at the coal mines.

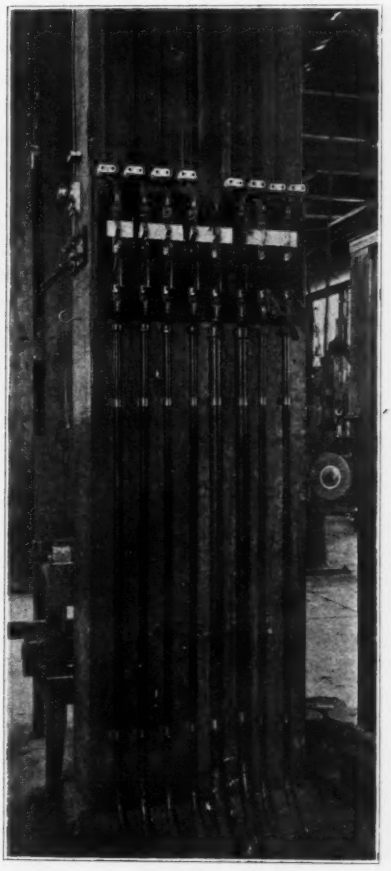


One of the Motor-Driven Boring Mills, Fore River Shipyards.



One of the Motor-Driven Lathes Turning a Crank-Shaft Forging, Fore River Shipyards.

The power plant for coal-mining purposes differs but little if any from the modern power-house for operating surface electrical systems. The power-house is located at the mine openings or main entrance, and at once supplies motive power for operating the haulage system, power for operating the electrical coal-cutting machinery and for operating the track switches, tripple machinery, and at the same time drives the powerful fans which pump air into the mines. This same power-house furnishes the electric light for the mine, and when a shaft mine is operated by electricity the plant also operates the hoisting machinery. When a coking plant is operated in connection with a coal mine the electrical power system is also extended to the operation of the coke ovens, an electrical haulage system supplanting the old-time larry system which was formerly in use to convey the loaded coal cars to the ovens. There are numerous other uses to which this modern agent is subjected in coal mining. Among them may be mentioned the operation of coal drills, the explosion of blasting charges used in coal mining, the operation of the pumps which keeps the mine clear of water. The telephone is also widely used in coal mining now, and it is possible for one outside of the mine to talk with every part of the mine.



Method of Leading in Conductors to a Shop Centre of Distribution, Fore River Shipyards.

The first application of electricity to coal mining was in the form of electric lighting which, some twelve or fifteen years ago, was introduced to the main entries of mines, and this lighting system has been gradually extended until the en-

tire mine is now well lighted, and in this way the necessity of mine lamps has largely been done away with. The perfect insulation of the electric light wires has removed all danger of explosions resulting from the wires, and by supplanting the mine lamps another frequent cause of mine disasters has been removed.

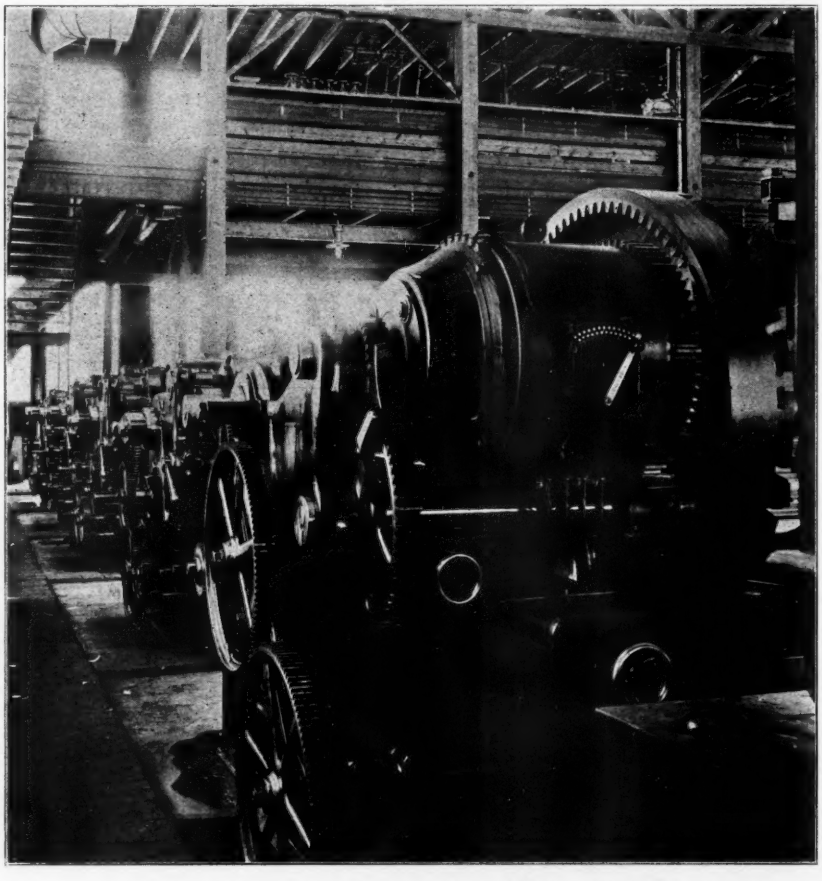
Electrical mine haulage came next in the general advent of these ideas into coal mining, a number of such systems having been installed in the anthracite and bituminous coal fields of Pennsylvania ten or twelve years ago. The first attempts along this line consisted of the introduction of a trolley system similar to that in use for street-car lines. While this system proved a marked improvement over the mule-haulage system, it was soon found that an overhead trolley wire in a mine of six or eight feet in the clear could not be operated with complete success. Frequent deaths resulted from the miners coming in contact with the wires and other trouble was experienced. Finally the improved mine locomotive was evolved, and this machine seems to solve the problem of mine haulage. These locomotives are now used in nearly one-third of the mines in the country, and their introduction is just now very rapid, nearly every new mine being equipped with these locomotives.

There are now something like 3,500 mechanical coal cutters in operation in the bituminous coal fields of this country and more than 100,000 persons are employed in their operation, while in the United Kingdom there are less than 400 of such coal cutters in use. There are a number of types of the electrical coal cutter as used in this country, and these machines are built in sizes to suit the requirements of the different coal seams. Among these types of electrical coal cutters may be mentioned the Jeffreys, the General Electric Company machine, the Morgan-Gardner machine, the Link-Belt machine and the machine manufactured by the Pittsburg Mine Manufacturing Company. There are also a number of compressed-air machines which are in use in the country, but the electrical machines form by far the greatest number of automatic coal cutters in use.

One advantage possessed by the electrical machines is found in their compactness and in the ease with which they can be manipulated. The electrical motor applied to chain coal cutting is safe and economical. The chain-cutting machine is the type in general use. A multipolar motor with armorclad armature and two field coils is used with this machine of which it really forms a part. A machine of this type consists of the motor, the carriage which is operated on the mine tracks, and the cutting frame. The standard machine of this type will undercut a distance of five feet, and to a width of nearly four feet, the motor varying from 220 to 500 volts potential.

Without going further into a description of this important advancement in coal mining it may be said that the increase during the past decade in coal mining has been largely due to this improved machinery. In 1890 this country produced 111,000,000 tons of soft coal, while the production in 1900 was 208,000,000 tons and in 1901 over 220,000,000 tons. For purposes of adjusting mining scales it is estimated that one electrical coal cutter will do the work of twelve men. While the machine displaced a large amount of hand labor the labor thus displaced is employed in handling the increased production of coal made possible by the operation of this improved machinery. While it requires only one man to operate one of these machines a number of men are employed in loading the coal cut by the machine, while others are required in following the machine and mining by pick the coal at the bottom of the mine which can not be mined by machinery. Eight drivers and as many mules were formerly employed in hauling 200 tons of coal to the surface per day. Through the introduction of improved mining machines and electrical haulage the output of the mines has been increased from 200 tons daily to ten times that amount, and a mine producing 5,000 tons per day is no uncommon one in the bituminous coal fields. While the cost under the old system of hauling the coal to the tipple was more than five cents per ton it is now less than one cent per ton. Automatic loaders operated by electricity are also in wide use, and there is very little hand labor required in handling the coal from the mining machine until it is loaded on the railroad cars or river barges ready for shipment.

The same general introduction of electricity is to be seen in the mining and handling of anthracite coal, the Pennsylvania anthracite coal field, although confined to an area of less than 500 square miles, now having an annual output of more than 60,000,000 tons. Through the introduction of the steel coal tipple and the complete equipment of the tipple with electrical apparatus it is now possible to screen the coal and load it on the cars for shipment at a very low figure. The automatic box-car loader is another modern economizer made possible through the introduction of electricity to the coal-mining industry. The application of electricity to the coal-handling business is still further exemplified by the great piers, modernly equipped, now in operation at the Atlantic ports and at the lake ports.



HEAD STOCKS OF SOME OF THE MOTOR-DRIVEN LATHES IN THE MAIN MACHINE SHOPS OF THE FORE RIVER SHIPYARDS.

ASSOCIATION OF ELECTRICAL MANUFACTURERS.

REPRESENTATIVE MANUFACTURERS PLANNING AN ASSOCIATION ON LINES SIMILAR TO THE NATIONAL ELECTRICAL SUPPLY DEALERS.

A number of manufacturers of electrical appliances and supplies were in New York city last week. On Friday a preliminary meeting was held and it was decided to form an association composed of the manufacturers who supply products to the electrical supply dealers. It was deemed advisable to do this so as to secure unanimity of action and for the purpose of regulating the individual attitudes of the manufacturers.

The new association, it is understood, will be formed on somewhat similar lines to that of the National Association of Electrical Supply Dealers. The manufacturers represented will comprise the leading ones throughout the country. Mr. H. B. Kirkland, of the American Circular Loom Company, Chelsea, Mass., manufacturer of "electroduct," and Mr. D. C. Hemingray, secretary and treasurer of the Hemingray Glass Company, of Covington, Ky., a leading insulator manufacturer, are active in planning the organization and with others were present at the preliminary meeting. It is planned to hold another meeting in this city in the course of a few weeks, at which time a permanent organization will probably be effected.

Electrical Resonance of Metal Particles.

R. W. Wood has made some experiments which lead him to believe that he has found a new type of light absorption, which it may be possible to refer to the electrical resonance of small metallic particles for waves of light. The experiments of Garbasso and Aschkinass have shown that a plate of glass covered with uniformly arranged strips of tin-foil of equal size, which serve as resonators, shows the phenomenon of selective transmissions and reflection for electromagnetic waves of different wave-lengths. In other words, a plate of this description exhibits the electrical analogy of surface color. The author has succeeded in producing metallic deposits on glass which the microscope shows to be made up of particles smaller than the wave-length of light which, by transmitted light, exhibit colors quite as brilliant as those produced by aniline dyes. He is unable to explain these colors by the principles of interference and diffraction and at the present he favors the hypothesis of electrical resonance. The metallic deposits are obtained by heating small fragments of the alkali metals in glass bulbs, thoroughly exhausted and hermetically sealed. Only the small portion of the bulb on which the metal particle lies is heated, leaving the remainder, where the condensation is to take place, quite cold. The metallic film which condenses on the wall, when viewed by transmitted light, shows colors of excessive brilliancy, as brilliant, in fact, as films strongly stained with aniline dyes. Metallic films obtained in other ways, as by chemical or cathodic deposition, do not show these colors. Thin films of metal show a more or less marked color by transmitted light, but the color is fixed for any definite metal, and, except in the case of gold and silver, not very pronounced. The sodium films, on the contrary, may be deep purple, blue, apple-green or red according to conditions. The diameter of the particles, as measured with the micrometer, varies from about 0.0003 mm. to 0.0002 mm. In other words, they are of about the size of the smallest micrococci described by the bacteriologists. Local heating to a slightly higher temperature drives off the film entirely, leaving the glass perfectly clear. By means of a small flame, it is possible to drive a patch of color all over the inside of a bulb, and it is in this way that some of the best films are prepared. It was found that cooling the films by the application of ice to the exterior of the bulb produced most extraordinary changes of color. Pale green films, almost transparent, on being cooled ten or fifteen degrees, change to a violet as deep as that shown by dense cobalt glass. Pink films change to a deep blue-green, while films originally deep blue become transparent. The author believes that we have color phenomena quite unlike any that are already known, and which are of some interest, regardless of the ultimate explanation which may be given them.—*Electrician*, April 11.

The Society of Chemical Industry.

A meeting of the New York section was held at the Chemists Club, 108 West Fifty-eighth street, on Friday, April 25. Papers were read on several interesting subjects.

Consul T. H. Norton, of Harput, under date of February 24, 1902, reporting the results of a recent trip in the vilayet of Diarbekir, says that the magnificent copper deposits at Arghana Maden, in the Taurus Mountains, are being steadily mined and bring a revenue of over $130,000 to the town. The methods of mining and the smelting processes, however, are the crudest.

A Large Mexican Power and Electric Company.

The Guanajuato Power and Electric Company, which has recently been incorporated with a capital of $3,000,000, principally furnished by New York, Boston and Denver parties, is to construct a 12,000-horse-power water-power plant in Mexico for the purpose of furnishing electric energy for traction lines, manufacturing plants and lighting used in two Mexican cities, and supplying power for general utilization in six other Mexican towns in their vicinities. The main plant is to be built in Cemora, and power will be conveyed to the city of Guanajuato by means of a transmission line 125 miles in length. While it has not yet been determined what the exact voltage of the proposed line will be, it is estimated that it will not be less than 40,000 volts. The city of Guanajuato is in the centre of one of the largest mining districts in Mexico, and the probability is that several of the mines will be operated by electric power to be derived from the Cemora plant. The local tramway company, horse road somewhat over two miles long, will be converted into electric motive power and considerably extended. Several other large tramway systems will be converted for the use of electricity, and there are several large factories in the vicinity which will allow an outlet for a large amount of power. Construction work has already been begun and the entire system is expected to be completed inside of two years. It is estimated that nearly $2,500,000 will be expended in material, equipment, etc., and all of this will be purchased in the United States.

Always a Welcome Visitor.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

The ELECTRICAL REVIEW has always been a welcome visitor at my desk, and I would not like to be without it.

JACOB CLOOS.

Milwaukee, Wis., March 16.

Another Year.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

I have yours of the 26th of February, and enclose you herewith check for the ELECTRICAL REVIEW for 1902.

J. SHALER HODGES.

Troy, N. Y., March 9.

Magnificent Journal.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

Herewith find check for ELECTRICAL REVIEW for present year. I fully appreciate the magnificent journal you are publishing.

S. H. MONELL.

New York, March 8.

LORD KELVIN.

THE DEAN OF THE ELECTRICAL ENGINEERING PROFESSION.

William Thomson, Baron Kelvin of Largs and Knight of the Grand Cross of the Royal Victorian Order, was born on June 25, 1824, in Belfast, Ireland. His father was James Thomson, a descendant of a Scottish farming family which had settled in Ulster some generations before.

In 1832, when young William was eight years old, the family moved to Glasgow, where his father had been appointed professor of mathematics in the university. The early education of young Thomson was received from his father, up to the time of his entrance in the university at a very early age. He gained, among other honors, the first prizes in the junior and senior mathematical classes, and won, in 1838, a university prize for an essay, entitled "The Figure of the Earth." In 1839 he went to St. Peter's College, Cambridge, whence he graduated, in 1845, as second wrangler, also winning the highest mathematical honor. Outside of his intense application to mathematics and science he was noted as proficient in many other studies, and participated very fully in both mental and physical recreations. He was an enthusiastic athlete, the president of the musical society of the university, and an amateur oarsman of renown.

From Cambridge he went to Paris, where he studied for a time under Regnault. All of this time he was publishing papers, having begun even then the extraordinary career which has marked him as one of the most astonishing universal geniuses that has been produced by the race in late years. His first published paper was written when he was only sixteen years old, and was printed in the Cambridge *Mathematical Journal*. It is a defence of certain fundamental theorems in Fourier's "Harmonic Analysis," certainly a somewhat recondite subject for a boy of sixteen. The next year he published papers on heat conduction and the connection of this subject with the mathematical theory of electricity. In 1846, being then twenty-two years old, he was appointed professor of natural philosophy in the University of Glasgow, a position which he held continuously for fifty-three years. His inaugural paper dealt with the method of finding absolute geological dates from observations of underground temperatures, a subject in which Professor Thomson was deeply interested. His conclusion, which is classical, placed the age of the earth at between twenty million and four hundred million years, and the method employed in this beautiful piece of mathematical analysis is now familiar to every student of mathematical physics.

Some years later he dealt another blow to a hypothesis which was commonly current among geologists in showing that it was impossible for the earth to consist of a molten mass with a thin solid crust about it. He demonstrated that the earth must be at least as rigid as steel, a prediction that was afterward verified by Mr. George Darwin. During the early years of his professorship he gave much attention to problems of astronomical physics, especially in regard to the origin, the total amount and natural loss of the sun's heat, the temperature of the sun, and other subjects of the same character.

It was, however, in the field of telegraphy that Thomson first won recognition as a great engineer. The first section of submarine cable in the British Isles was laid, in 1846, in Portsmouth Harbor. Shortly afterward cables were laid across the British Channel and subsequently across the North Sea to Ireland, and by 1855 the Mediterranean was crossed by a network of cables connecting various important points. His attention being called to the cable problem, in 1854 he elucidated the law of the effect of distributed capacity—the famous "law of squares." It was at this time that the gigantic undertaking of building a submarine telegraph line across the Atlantic Ocean was first agitated. Professor Thomson became the engineer of the cable promoters and immediately attacked the practical problem in that audacious enterprise. He found, for example, that the conductivity of copper supplied by various makers differed by as much as fifty per cent. In 1858 he produced the mirror galvanometer for receiving cable messages. This instrument, the construction of which is now known to all electricians, proved so sensitive as to indicate signals sent across the Atlantic by means of a battery consisting of a gun cap, a needle and a drop of salt water.

In 1858 Professor Thomson took upon himself the duties of electrician on board of H. M. S. Agamemnon of the British Navy, which was placed at the disposal of the cable company. It will be remembered that the United States warship Niagara was sent out from the American end of the line, and that the ships met and successfully established communication between Ireland and Newfoundland in the summer of that year. On August 6 the Thomson galvanometer delivered the first message, proving the commercial feasibility of the transatlantic cable. This cable lasted only a fortnight, during which time four hundred messages were transmitted. Seven years elapsed before sufficient capital could be secured to renew the effort. The great American civil war had broken out in the meanwhile, and this was largely responsible for the failure to renew operations.

During the intervening years Professor Thomson continued his experimental and mathematical investigations, and still further improved the instruments and methods destined for the new cable. On July 16, 1866, a successful cable was finally laid, and is still working. On the return of the expedition to Great Britain the triumph of Professor Thomson was suitably recognized by his investiture with the order of knighthood.

Swifter methods of receiving signals were commercially desirable, and in 1870 Thomson's siphon recorder was put to work on the transatlantic lines and is to-day still the standard instrument in use on practically all of the cable lines of the world.

Always an enthusiastic yachtsman and sailor, Sir William Thomson soon began to turn his attention to the improvement of methods of navigation. In 1872 he invented great improvements in apparatus for taking deep-sea soundings, using for the first time steel pianoforte wire instead of hemp rope for this purpose.

In 1874 he undertook to write an article on the mariner's compass, of which the first part was published and marked "to be continued," but not until five years had passed was the continuation given to the world. The reason was that he had seen how greatly the device might be improved and had set himself, during the interval, to make changes in accordance with his investigations of the subject. Strangely enough, the improved compass found little or no favor at first, and it was not for thirteen years after its appearance that it was adopted by the British Admiralty. One of the principal features of this compass was the use of soft iron masses to compensate the various errors due to the magnetic influence of the ship. It is fair to say that, to-day, the art of navigating steel and iron ships is practically dependent upon the Thomson compass. In 1876 Sir William Thomson published a complete set of tables adapted to the simplification of Sumner's method of finding the position of a ship at sea, by which this valuable method was brought within the ability of the ordinary seaman or navigator.

Taking up the important subject of the tides, he devoted many years to the study of a method of investigating and predicting the tides at all parts of the world. This investigation was fully carried out to a very successful and satisfactory conclusion.

Lord Kelvin's physical genius has been shown no more completely in any direction than in his work on thermodynamics. It would transcend the limits of the space at disposal here to go into the subject of the masterly work he has done in this most important branch of physical science. From the date of his paper, in 1851, on the dynamical theory of heat may really be said to commence the modern conception of thermodynamics, and, indeed, the practical demonstration of the great principle of the conservation of energy.

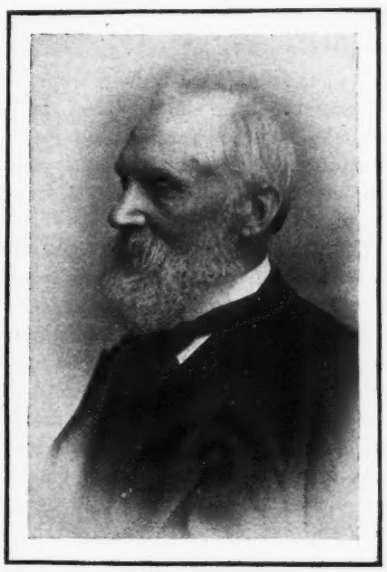
In 1853 he published a paper on "Transient Electric Currents," which gave the impetus to a number of investigations that have subsequently resulted in a great advancement of knowledge. Here for the first time was considered the oscillating discharge of a condenser, and the foundation laid for the brilliant work of Hertz upon electric waves. In 1853 he also invented the absolute electrometer.

Even to catalogue the important list of inventions made during these middle years of Lord Kelvin's career would fill columns of this publication. He was associated with most of the early work in the determining of the absolute electrical units of various kinds, and with some of the largest problems in electrical engineering that were prominent in those days. In 1890 he was made chairman of the International Commission, which examined the various plans for the generation and transmission of power at Niagara Falls.

Perhaps one of the researches with which Lord Kelvin's name will always be most closely associated is that going into the constitution and mechanism of the ether. In all, he has written more than three hundred papers on electrical, mathematical and physical subjects, of which many have been given to the study of the ether and its phenomena. The work in collaboration with Professor Tait, of Edinburgh, entitled "A Treatise on Natural Philosophy," has been one of the standard and most valuable publications of its character that has ever appeared.

In 1891 Sir William Thomson was made president of the Royal Society, and in the same year was elevated to the peerage, a distinction then unique in the annals of science. The list of the honors conferred upon him by foreign governments and societies is a long one. He is a Grand Officer of the Legion of Honor, a Knight of the Order pour le Mérite, and is an honorary member of most of the important scientific and engineering societies of the world. No less than fourteen universities have conferred upon him their degrees of doctor. All of these titles and honors, however, fall short of the extraordinary honors conferred upon him when, in 1896, he celebrated his jubilee as a professor in Glasgow University. Then his students gathered from almost every civilized country of the globe and with them professors and representatives of scientific societies, and probably never before had such a distinguished company of scientific men been gathered together to do honor to one man.

Lord Kelvin was thrice married. To-day, in his seventy-ninth year, he is still



Lord Kelvin.

a hale and vigorous man and still notable for the extraordinary activity, both intellectual and physical, that has marked a career practically unique among those of scientific men.

RECEPTION TO LORD AND LADY KELVIN.

BRILLIANT RECEPTION TENDERED BY THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS AND SISTER SOCIETIES AT COLUMBIA UNIVERSITY.

On the evening of Monday, April 21, a reception by the American Institute of Electrical Engineers, Columbia University, the American Association for the Advancement of Science, the American Physical Society, the American Mathematical Society, the Astronomical and Astrophysical Society and the New York Academy of Sciences was tendered to Lord and Lady Kelvin. The reception was held in the great gymnasium of Columbia University and was very largely attended by a brilliant audience, including some of the most famous representatives of science and engineering in this country. Addresses of welcome were delivered by Dr. F. B. Crocker, of Columbia University, who introduced the other speakers, President Nicholas M. Butler, of Columbia University, on behalf of that institution; Professor Elihu Thomson, on behalf of the American Institute of Electrical Engineers; Dr. A. G. Webster, on behalf of the American Physical Society, and Dr. R. S. Woodward representing the other societies.

All of these gentlemen took occasion to refer to Lord Kelvin's brilliant contributions to science, and most of them laid special stress upon his work in connection with the transatlantic cables. When Lord Kelvin arose to respond the audience rose in greeting to him and applauded him enthusiastically for several minutes. The guest of the evening spoke at some length.

Beginning with some graceful references to the speakers who had preceded him, and expressing in the most cordial terms his thanks for the reception tendered him, Lord Kelvin said that the meeting was not only one of welcome to the citizens of another country, but also a union of the sciences. He referred to the fine work being done by Columbia University, and spoke in eulogistic terms concerning the great American who had been the father of the cable enterprise, Cyrus W. Field. He told at length of the trial and difficulties encountered in laying the first Atlantic cables from the date of the first attempt to the successful conclusion of the work in 1866. Referring to the first cable, which worked for two weeks and over which about 400 messages passed, he told of one message of unusual importance which countermanded orders previously issued to send two regiments of soldiers from Canada to India to assist in quelling the great mutiny. Referring to the famous story of the battery made of a gun-cap, a zinc wire and a tear, he remarked that if such a battery could give a visible signal surely tears enough were shed when the cable broke down to have furnished motive power for it for a long time. He spoke of the advancement of science during recent years and particularly of wireless telegraphy which, in his opinion, was interesting and valuable but would not be a competitor of the cables.

He said that America was always to him a country of inspiration and told of his early visits and the benefit he had derived from them. A reference to Mr. Edison produced tremendous applause which was not stilled until the veteran inventor, who was seated modestly in the back row on the platform, arose to bow his acknowledgment.

Lord Kelvin spoke finally of the Niagara power transmission and ventured the prediction that it would be considered more beautiful some day to see all the water of the great cataract turning turbine wheels than to see it thundering over the cliff, as it does to-day, an untamed waste of power.

The conclusion of Lord Kelvin's remarks was greeted by three cheers and much applause, and a portion of the audience filed across the platform and were presented to the guest of the evening and Lady Kelvin.

NOTES ON X-LIGHT.

BY WILLIAM ROLLINS.

NOTE CXXXVIII (*Continued*)—PUMPING X-LIGHT TUBES.

Pumps for exhausting X-light tubes should have connected with them an oven made of iron which is covered with a non-conducting material, outside of which there should be a sheathing of some material like lead or white lead in Japan, which is opaque to X-light, for it is an injury to a workman to be near powerfully excited tubes day after day. The power of X-light for harm was well shown in some experiments on animals which were reported in part in the Boston *Medical and Surgical Journal* for February 9, 28; March 28, 1901, and January 9, 1902. The experiments showed not only that X-light could burn, but that it could kill the fœtus and cause death in adult animals.

The oven should have a thermometer which can be read from the outside; a window of lead glass an inch thick or made of several layers through which to see the tube; another window of aluminum through which to see the quality of the X-light with the fluoroscope. This aluminum window should have a swinging shutter of non-radiable material to cut off the X-light when it is closed, as it should always be except when at intervals it is necessary to test the light, because the experiments mentioned showed that aluminum even when grounded, as recommended by Tesla, was powerless to prevent burning, abortion and death, as these results were produced through two sheets of aluminum, one of which was grounded. These experiments were of importance, because they were the first in which all other agents besides X-light were excluded as factors in the results, and they therefore clearly showed that the precaution which a few careful operators have used and which was recommended by Tesla to prevent burns was not efficient, they also proved that all kinds of X-light, whether from high or low-resistance tubes, would produce not only burns, but death in animals. They therefore showed "the great importance of always using an X-light tube in a non-radiable box from which no X-light can escape except the smallest cone of rays which will cover the area to be examined, treated or photographed." This matter of enclosing a tube has been frequently mentioned in these notes, and a number of such tube boxes have been figured, but as its importance is not yet recognized it will be considered in a future note, illustrations being given of such a box which has been developed as the result of experience since the earlier forms were described.

The oven in which the tube is placed for pumping should be so far removed from the pump that the heat shall not affect the mercury or drive off water vapor. This may easily be done by making the tube connecting the X-light tube with the pump about fifty-six centimetres long. Having such an oven, the tube is to be placed in it and heated to a temperature of 560 degrees Fahrenheit to burn out the organic matter deposited on the walls from the workman's breath and on the terminals from his hands; to drive out gas from the glass from the regulator chemicals or the stuff used to hold them from entering the main tube. Glass wool is the best material for this purpose, as asbestos gives off gas. Neglect to follow this advice has caused much trouble in pumping tubes.

The heat also drives off the gas from the surfaces of the terminals and prevents mercury vapor from condensing in the tube. No current should be sent through the terminals until this stage is passed. Before the current is used we must also be sure that gas is not entering the tube from other sources such as leaks in the tube, in the fork, in the joints, from the grease used to make the joints tight or from the water vapor or mercury of the pump, if a mercury pump is used. During the whole process of heating the pump should be kept in action until the bubbles of the gas stop appearing in the outlet valve.

Then begins the second stage of preparing the tube to which the name "tuning up" has been given. It has already been shown "that we depend upon gases amalgamated with the terminals to produce an efficient cathode stream for making X-light," "that the process of pumping a tube consists not only in removing the right amount of gas from the tube, but in driving out the proper amount of gas from the terminals that what remains will not come out so fast, when the tube is used, as to lower the resistance until the X-light is not of suitable wave length."

When the first stage, or that of heating and pumping without current, is complete, the tube may be cooled to the temperature of the room. Next connect it with a source of current of the same volume and delivered in surges of the same kind and size and at the same intervals which will be afterward used in practical work. The reasons for this are plain: First, if less current is used during the subsequent pumping than will be employed in practical work afterward, it will be found, when the tube is sealed off and used, that the stronger current will drive gas into the tube until the vacuum is so low the tube is useless, for the wave length of the light will be too long to be suitable for the work in hand, or the vacuum may be so low that ordinary light alone will come from the tube, because the subatoms (*American Journal of Science*, page 391, 1900) of the cathode stream will meet with such obstruction on their way to the target that they will strike with too little velocity to be raised to the proper temperature to produce the short ether movements we call X-light. A few experiments will show why not only the amount of the current passed in a given time must be considered, but also the size of the surges. It is only necessary to increase the size of the surges, diminishing their number (to keep the amount passing in a given time the same), to see how much gas the larger surges will drive out. A tube which has been tuned up with small though frequent surges until the vacuum remains in proper condition under such surges may be spoiled by a few more powerful ones. This is what generally has happened when tubes have been tried on powerful generators. It is the chief reason why such apparatus has been condemned, not only by tube-makers, but by physicians who have attempted to work with it. On this account in note xxix the statement was made that a tube should always be pumped with regard to the generator on which it was afterward to be used. The facts also point out how important it is for every coil to have some means of measuring the energy that it is delivering to the tube. Having arranged the current in the proper manner the pumping is to be continued until the resistance of the tube does not fall too low in a reasonable time while the current is on. Then, if there is no vacuum regulator, the tube may be sealed off, as it is finished. If there is a vacuum regulator this should be heated either by a lamp, a flame or by electricity, if the regulator is of the type shown in the figure, until the light yielded by the tube is of the longest waves which will ever be required in practical work. The regulator should then cool. If the resistance rises to the former point all is well. The tube may be sealed and marked to show how much current should be used with it. If the resistance does not rise to the proper point there is too much gas in the regulator. The heat on the regulator must be continued with the pump in action until

by trial with the current the vacuum is found to remain at the desired point when the regulator cools. Then the tube can be sealed and marked. If there is no vacuum regulator that liberates gas, which it reabsorbs on cooling, but one which is only used to permanently lower the vacuum (when through use this has become too high), the second operation of tuning up the tube can be carried on at a temperature of 300 degrees Fahrenheit. In this case the tube should be cooled before it is removed from the pump, to test its resistance, which should be equal to three centimetres of air between polished brass balls two centimetres in diameter. If the regulator is of the first type the resistance may be left at twenty-eight centimetres for very powerful coils.

PUMPS.

Either a mercury or a mechanical pump may be used in exhausting tubes, for the process of removing air from a tube is a simple one which may be done in a few minutes. The tuning up is where the time needs to be spent. Ignorance of this has caused experimenters to go on complicating the mercury pump with the idea of increasing its efficiency until some of the modern forms are forests of glass tubes branching in every direction. The best work on mercury pumps is S. P. Thompson's little known pamphlet. Fortunately, owing to the date of publication, some of the most complicated pumps are not described. One of the features on which investigators have spent the most time is in multiplying the number and complexity of the drying tubes. A mercury pump should be simple, with as few joints and tubes as possible. One drying bulb of a globular shape, kept filled with fresh phosphoric anhydride (the word fresh should be written in large letters), is enough. The best mercury pump is that of Mr. W. E. Oelling, for he has swept away all useless parts, reducing the matter to the simplest expression. In this pump the valve controlling the rise and fall of the mercury is operated by hand.

Though much time has been spent during the experiments, which have been partly reported in these notices, in making the action of the valve automatic, the results, though successful, have shown that the simpler hand method is good enough. To operate the mercury pump the Packard pump is the best. It is well designed, well built, durable and efficient. All mercury pumps give off mercury vapor. As this vapor in a tube is injurious, it should not be allowed to get there. To prevent it, the glass tube connecting the vacuum tube with the pump should be filled with metal foil such as is used by gilders. There should be a plug of glass wool above and below. As the vacuum rises in a tube Geissler effects show themselves through the pump when the current is used for tuning up the terminals. Although the appearances are very beautiful when the room is dark, they are like some other beautiful objects, a cause of misfortune. They liberate water vapor which, entering the tube, lowers its resistance. If the current is kept on during the additional pumping required to remove the water vapor, in ignorance of the cause of the lowering of the vacuum, the terminals will become so exhausted before the proper degree of vacuum is reached that the tube will be dull and without value. If a tube can not be exhausted in a short time the result will never be good on account of terminal exhaustion.

To prevent water vapor from entering the vacuum tube a platinum wire should be sealed into the tube leading to the pump. The point where the wire is inserted should be well within the hot oven that the Geissler effect may stop near the vacuum tube. The wire should be grounded.

(To be concluded.)

Consul Worman reports from Munich, March 4, 1902, that, according to the newspapers, a Hamburg chemist has discovered a fluid which, when added to ordinary water, produces a liquid that can not be distinguished from petroleum. It can be used for lighting as well as for heating purposes. When burned in a lamp with an ordinary wick it gives an extraordinary white light of double the strength of a petroleum flame. The fluid is not explosive. A company, it is said, has been formed in London for the exploitation of this discovery.

By treating fused mixtures of aluminum and magnesium in various proportions with ammonium chloride solution or dilute hydrochloric acid, three definite crystalline compounds of the two metals have been isolated by Mr. Boudouard. All the fused mixtures of the two metals, except that containing equal parts of each, show dendritic crystals in considerable quantity.

President John I. Sabin, of the Pacific States Telephone and Telegraph Company, San Francisco, Cal., has ordered the installation of telegraph apparatus in telephone stations to be operated in common with the telephone instruments over the telephone lines.

COST OF CONSTRUCTION AND MAINTENANCE OF TELEPHONE LINES.*

BY H. S. HERR.

To serve three or four hundred with telephone service at prices charged before there was competition was easy and productive of very high dividends. But to serve two and three times as many at one-half and one-third the price is quite a different proposition. To make this more plain: Consider a town where there is an exchange with 300 subscribers at $3 monthly, the minimum price charged by the old company before competition. And then consider an independent company building an exchange in the same town, charging a rate of $1 per month, and securing 1,200 subscribers, which is the real condition with many of the independent telephone companies to-day. The subscriber receives for $1 per month the benefit of 1,200 subscribers, which at the old rate of $3 for 300 would cost him $12 a month.

This very low rate is all very good for the subscriber, but the independent people when going into the telephone business did so underestimating the cost of construction and maintenance, believing that the more subscribers they secured the less the rate for service would be. It never occurred to them that the reverse was true, that the greater the number of subscribers the more expenses attached to the transaction of the business. This is still the impression among all classes not versed in the financial propositions relating to the telephone business. They still believe that the more telephones a company can put out the less the rate should be.

The proper understanding, by the general public, of the cost of construction and maintenance is as important in the telephone situation of to-day as it is that every telephone man should understand it for himself. Men generally are willing to pay for what they get when they know what they are getting. This knowledge, generally diffused among the people, will be a safeguard against unwise legislation in telephone matters or ill-advised interference by city or town councils. I consider this the most important proposition before us to-day. The cost of construction is continually advancing; it is fifty per cent higher than it was six years ago. Telephone poles, wires, cross-arms and all material required in toll-line construction have advanced ten to fifteen per cent in the past year, and at the present rate of pole consumption in a few years it will be

*Read before the Interstate Telephone Convention, Chicago, April 10, 1902.

impossible to buy them at any reasonable price.

And, since it has been demonstrated that it is practicable to place the wires in conduit along the principal thoroughfares this will be required by all towns in the near future, the same as at present in the larger cities. This cost is considerably above that of the ordinary pole, wire and cable construction. The demand is so great for telephone service that to supply all in densely populated districts will require such a great network of wires overhead that it will not be permitted in well regulated towns. The only solution will be underground conduit and cable construction.

HOW TO ESTIMATE THE COST.

The cost of a telephone plant can be quickly estimated, approximately, at the present prices of material and labor, on a basis of the number of telephones installed. For example, an exchange of 500 telephones installed within a radius of one and one-half miles and no conduit or cable work, but up-to-date construction, will cost approximately $65 a telephone, or $32,500; this will come so near to the real cost that a company can base its calculations on it with a degree of certainty. As the number of telephones increases, the radius or distance from the exchange will also increase, and therefore the cost. In estimating on 1,000 telephones installed, we must take into consideration some aerial cable, and more substantial construction and much more costly equipment, and therefore there would be a material increase in the cost per telephone, without conduit work; a safe approximate would be $85 per telephone, or $85,000 for the plant, within a given radius.

Where the demand for telephones exceeds 1,000, and quick, up-to-date service is required, it is absolutely necessary to be equipped with central energy and multiple switchboards, and when in towns where electric light and electric street cars are used, requiring many additional appliances to overcome the interference caused by them, and where it is necessary to construct conduits, we can not with safety calculate less than $100 per telephone installed; that is, 1,000 telephones under such conditions would cost to install, approximately, $100,000. These prices are only approximate and may vary ten or fifteen per cent, according to local conditions. In large cities, where 5,000 to 10,000 subscribers are connected, the cost will approximate from $150 to $200 per telephone installed.

THE COST OF OPERATING AND MAINTAINING.

Very few who are engaged in the independent telephone business knew the expense of operating or the cost of maintenance, even approximately, when they entered into the business, much less did they consider that the expense increased, not only proportionately to the number of subscribers, but in an arithmetic progression. To explain: The expense of operating an exchange of 1,000 subscribers is much more than twice the expense connected with an exchange of 500. At first thought we naturally say that if you can give service to 500 subscribers at $1 per month, you can give service to 1,000 for less. Practice proves just the reverse. The reasons why are many, some of which may be plainly understood by the following:

When there are 500 subscribers connected with an exchange, each subscriber can call up 500 others, and by the time every subscriber calls up every other subscriber there are sent through the exchange 250,000 calls; when there are 1,000 subscribers and every subscriber calls up every other subscriber once, there are not only twice as many calls sent through the exchange as there were when only the 500 were on the board, but four times as many, making 1,000,000 calls, which is the ratio in increase of the use of the telephone with the increase of subscribers. This requires four times as much labor to take care of 1,000 subscribers as it does to take care of 500, and four times as much wear and tear on the apparatus, and much more central machinery or apparatus to do it with. The same is true on outside construction. Consider that the first 500 subscribers are within a radius of one mile from the exchange, with an average of one-half mile of pole lines, and in full metallic circuit, it means one-half mile of wire out and one-half mile in; the second 500 come within a radius of two miles from the exchange, making an average distance of one and one-half miles for poles and wires, or three half miles out and three miles in, making the amount of construction to reach the outer 500 three times that of the first 500, and four times that required to serve the first 500 will be required to give service to 1,000.

I doubt whether this covers it all when we consider the amount of territory that must be covered by poles and wires as the circle increases. The territory to be covered in a radius of one mile is only a fraction less than four square miles. The territory covered in a radius of two miles is four times that, or sixteen square miles, requiring twelve square miles to be covered with poles and wires to serve the second 500 which, added to the cost of the first 500, would make four times as much pole cost to serve 1,000 subscribers as it requires to serve 500. To serve the out districts the wires can pass over the poles of the first districts, but the poles will have to be much larger and cost more. The amount of cross-arms and wires and insulators is the same as if all the wires were put on separate poles from the central office out.

MAINTENANCE.

There appears to be a general impression abroad among those who think but once that after a telephone line or telephone system is built that the work is done for all time. But that is not the case. Decay and trouble begin as soon as the poles are set. The average life of the white cedar poles as we get them to-day is from fifteen to twenty years. Galvanized iron wire in towns and cities can not be counted on for a period much beyond six or seven years. In the country this is much longer. The life of a switchboard is from fifteen to twenty-five years and longer with the constant repairing and replacing of parts giving out or wearing out as time goes on. Telephones have been an uncertain quantity till within a few years. There are a few telephones that have been used many years, proving that durable, efficient telephones can be made. But there are many that have been thrown away in a very few years, which is in accord with poor construction in everything. The best is what we want.

The expense of maintenance when good up-to-date appliances are used with the very best of construction should not and does not exceed three per cent to five per cent, so that we are on the safe side of our investment when we make a five-per-cent maintenance fund and a six-per-cent dividend. As we have already stated, the cost of maintenance increases much more rapidly than the number of subscribers. This is being understood by many and is evidenced by the franchises granted in different cities containing a clause granting the privilege to increase rate for telephone service as the number of subscribers increases.

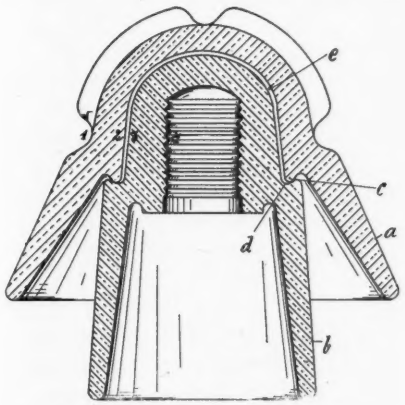
By examining the Bell rates of 1889 or 1890 and comparing them with the actual condition and experience of the independent people, I have come to the conclusion that the rate should have been established at about three-fifths of that of the Bell companies, all things being equal, which would give a bare remuneration on capital invested.

It would not have been a "get-rich-quick" business, but a clean investment, and justice would have been done to all.

The independent people have reduced the rate of telephone service, and by so doing the telephone has come into general use and become a public necessity in place of a public luxury. True, it has cost much money, and I have this faith in the people, that they will stand by the companies which have served them best.

Electrical Patents

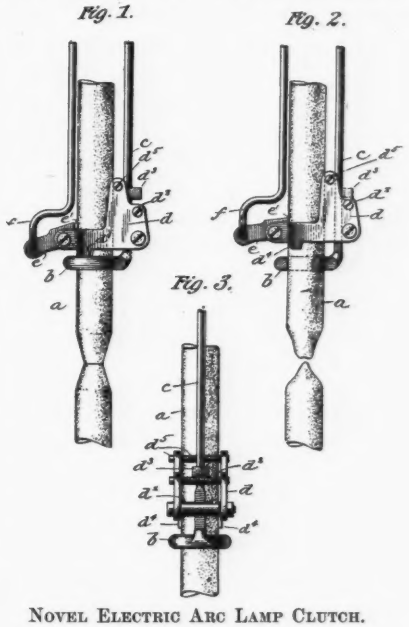
Considerable attention has been paid by inventors to the construction of insulators for high-potential currents, and several patents have been granted in which the insulators are constructed of several porcelain bells that are nested and connected by a layer of glaze. It is evident that bells which are to be connected together by the glaze must have a thick layer of glaze at their contact place. As, however, the porcelain glaze has a different coefficient of expansion from the mass of the porcelain it cracks in thick layers—that is to say, after cooling it does not form a homogeneous glaze, but a mass traversed by innumerable fine cracks and pores. These cracks in thick layers of glaze increase under variations of temperature and are further considerably increased in insulators exposed to the atmosphere when a current of very high



IMPROVED FORM OF INSULATOR.

potential is conveyed over the insulators, whereby the latter are considerably heated. It is evident from the foregoing that thick layers of glaze by reason of their liability to crack do not increase the insulation, but rather diminish it, and thus layers of glaze in the interior of the insulator only fulfill the object when they cover the mass in the ordinary thin layer. In order to avoid the above-mentioned drawback, Mr. Rudolf Gaertner, a resident of Merkelsgrun, near Carlsbad, Austria-Hungary, has devised an improvement for which he has obtained a patent in this country, and has sold his interest in the same to Karlsbader Kaolin-Industrie-Gesellschaft, of Merkelsgrun, near Carlsbad, Bohemia, Austria-Hungary. In the present instance the separate bells are so connected with one another that an interstice is formed between them in such manner as to afford an air-jacket practically enclosing the inner bell, and thereby the number of the glazed walls and also the space between the cable and the support are increased. The insulator shown in the accompanying drawing consists, for instance, of two bells, *a*, *b*, and has on its out bell, *a*, a projector edge, *c*, which is fixed in a corresponding annular recess, *d*, in the bell, *b*, in a second heating by means of a layer of glaze, so that between the two bells, *a* and *b*, an interstice or air-jacket, *e*, is formed. As the separate bells are provided with an even, thin layer of glaze on their outer and inner surfaces, an insulating layer is provided between the cable and the iron post or support, which is composed of the porcelain, four layers of glaze, 1, 2, 3, 4, and the interstice or air-jacket, *e*. It is evident that by this method of increasing the relative distance apart of the cable and the iron support, by increasing the number of layers of glaze inside the insulator and interposing an air-space or jacket, an insulation is produced which has great mechanical strength and resistance efficiency.

A novel electric arc lamp clutch has been invented by Mr. John Eberhardt, of Chicago, Ill., his object being to provide a device which will hold the carbon at its proper position regardless of shocks or jar to which the lamp may be subjected while in use, thus especially adapting it for headlights on trains and the like. The accompanying illustrations and following description are taken from the patent he has obtained on the same. The carbon electrode is indicated by *a*. It passes through a guiding ring, *b*, fixed horizontally to the lower end of a vertical standard, *c*, forming a part of the lamp frame. Above the ring, *b*, is the clutch frame, *d*, loosely encircling the rod, *a*; d^1 represents a roller adapted to roll against the flat surface of the lower end of the standard, *c*, to reduce friction in the movements of the clutch; d^2 is a screw passing through the clutch frame and adapted to impinge against the lug, d^3, on the standard, *c*, and limit the upward movement of the clutch. Opposite the roller the frame, *d*, is split to form ears, between which is pivoted a dog, *e*, having a gripping edge, e^1. The frame, *d*, is provided with the lugs, d^4, adapted to strike upon the upper side of the fixed ring, *b*. To the outer end of the dog is freely attached a rod, *f*, through which the clutch is operated. A guiding screw for the carbon, *a*, is represented by d^5. The usual electromagnet or solenoid which actuates the clutch is not shown, it being understood that the rod, *f*, is raised or lowered by such a regulating magnet or solenoid as is commonly used. In explaining the operation of the clutch it may be assumed that when the lamp is not burning the upper carbon, *a*, is resting upon the lower carbon. When the current is turned on, the regulating magnet raises the rod, *f*, causing the edge, e^1, of the dog, *e*, to bear against the side of the carbon and clamp it against the guide, d^5. Further movement of the rod, *f*, is accompanied by the carbon and continues until stopped by the screw, d^2, coming into contact with the lug, d^3. In this upward movement to strike the arc the traverse of the carbon is in perfectly vertical line, and no binding can take place because of the action of the roller, d^1. As the arc settles down to its normal burning length the clutch lowers to an intermediate position between those shown in Figs. 1 and 2.



NOVEL ELECTRIC ARC LAMP CLUTCH.

As the carbon consumes, the clutch gradually lowers until the lugs, d^4, strike the ring, *b*, and the edge, e^1, is released from the carbon by the further downward movement of the rod, *f*. When the carbon is thus released it feeds by gravity until again gripped and held by the dog actuated by the controlling magnet. The location of the roller back of the standard makes every movement of the clutch positive and exact, there being no loose joints or open places which might permit of the carbon working loose from the clutch in case the lamp is subjected to jarring or shocks. In the case of clutches heretofore used in this kind of service much difficulty has been encountered because of slight variations in diameter of the various carbons, the smallest departure from this standard size, for which the clutch is made, resulting in irregular feeding of the carbon.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

Fire Danger from Incandescent Lamp Decorations.

A number of experiments have been made in Great Britain showing that it is particularly dangerous to cover incandescent lamp bulbs with drapery and, notably so, to wrap them in cotton, especially in the case of colored lamps. With sixteen-candle-power colored lamps, cotton in contact with the lamp begins to smoke after ten minutes and sometimes even after three minutes. Only a slight draft of air is required to make the cotton burst into flames, when the bulb collapses on account of its walls softening from the heat. Low candle-power lamps seem to be as bad in this regard as larger lamps. Great care should be taken not to allow inflammable draperies and particularly those of a fuzzy or fibrous character to come into contact with bulbs of decorative lamps.—*Engineering* (London), April 4.

Discharge from Hot Platinum Wires.

Some interesting experiments have been undertaken to determine the relative velocities of positive and negative ions in the discharge from a hot platinum wire. An article by Rutherford has shown that at high temperatures the average velocity is less than at low temperatures. Mr. C. D. Child has discovered that the most rapidly moving positive ions have a greater velocity than the most rapidly moving negative ions. When such a wire is first heated in a vacuum, the discharge is much larger than at any time afterward. Heating the wire in hydrogen seems to restore to it the power lost in discharge. At least some of the discharge, the author concludes, would therefore seem to be due to occluded hydrogen.—*Science* (New York), April 4.

An Aluminum-Carbon Accumulator.

Dr. E. Semprún, of the Spanish Army, has devised a new form of secondary element using aluminum and carbon electrodes, of which some account has lately been given, but of which no particular details concerning the chemical reactions involved or the electrolyte employed have been made public. Plates are made of aluminum upon which is supplied a paste. A sample of the accumulator containing thirteen plates of 3,042 square centimetres surface weighed 6.39 kilogrammes as against a thirteen-plate lead accumulator having 2,619 square centimetres surface and weighing sixteen kilogrammes. The efficiency is stated to be about eighty-five per cent. The maximum charging current is stated to be eighteen amperes per kilogramme of the positive plate. The electro-motive force is from 1.75 to 2.25 volts. The normal output is stated to be 1.104 horse-power-hours per kilogramme of the positive plates. Short-circuits are said to have no deleterious effect. It is stated that the accumulator has successfully endured a four years' test, during which the electrolyte was renewed annually, and nothing further than the above is stated regarding the nature or operation of the cell.—*La Energia Eléctrica* (Madrid), March.

A Commercial Source of Hydrogen.

M. d'Arsonval required, in recent investigations conducted by him, large quantities of hydrogen gas. It occurred to him that the source of this gas might be ordinary coal gas, of which hydrogen constitutes usually about fifty per cent, the remainder being methane with small quantities of other gases and volatile substances. By the use of liquid air the methane and other ingredients were successfully condensed, leaving the hydrogen quite pure. In recent experiments M. d'Arsonval has dispensed with the use of liquid air and has simply passed coal gas, which was previously cooled to eighty degrees below zero centigrade, through a Linde liquid-air machine. In this way he was able to obtain 3,500 cubic feet of hydrogen per hour at an expenditure of from twelve to fifteen horse-power. By a modification of the process pure methane can also be furnished. This is accomplished by dividing the process into two stages. In the first the gas is cooled to the temperature of solid carbonic acid, causing the condensation of carbonic acid, benzine and similar hydrocarbon matters. In the next stage the methane is condensed, carrying with it in suspension such carbon monoxide as may be present, which may easily be filtered off.—*Engineering* (London), April 4.

Researches Concerning Lightning.

The Royal Institute of British Architects and the Surveyors' Institution of London organized last year a research committee for the purpose of obtaining accurate records of the action of lightning strokes on buildings. The object in view was to devise, if possible, an improved method of protection, and over 200 competent observers in the United Kingdom, besides a large number in the colonies and elsewhere, were to gather data. Innumerable photographs were taken, which often appeared to reveal conditions which verbal descriptions failed to represent. Out of sixty cases tabulated by the committee up to the first of this year no fewer than twelve relate to buildings fitted with lightning conductors of one form or another. Commenting upon a series of accidents caused by lightning to the factories of some explosive manufacturing companies in Germany, the inspectors state: "These accidents have done much to confirm a feeling of distrust which has for some time been growing in our minds as to the absoluteness of protection afforded by conductors erected in accordance with specifications laid down by the lightning-rod session of 1882." Continuing, the report states that the observed facts go far to confirm the interesting laboratory experiments made by Dr. Oliver Lodge. The committee is continuing its investigations. Members and others willing to assist by reporting their observations are requested to communicate with the secretary at No. 9 Conduit street, W., London.—*Engineering* (London), April 4.

The Decomposition Tension of Sodium Hydroxide.

Some interesting results have been obtained by J. B. Sicher in the study of the decomposition tension of sodium hydroxide. When this salt is fused in an iron vessel it soon assumes a red color, and

when this condition is reached the iron has become passive, so that on immersion of an iron wire into the fused mass there is no polarization current. Until this condition is reached the polarization current is observed. The only metals suitable for electrodes in the electrolysis of this compound are iron and platinum, of which the former is preferable. The discharge potentials and decomposition tensions of fused sodium hydroxide were determined in an iron vessel with an iron electrode and in a platinum vessel with a platinum electrode at various temperatures between 385 and 694 degrees centigrade. The curves of cathodic decomposition, as also those of anodic decomposition, show two well-marked breaks; for the former, at 1.16 volts at 390 degrees, and 2.06 volts at 389 degrees; and for the latter, 0.11 volt at 395 degrees, and 1.31 volts at 393 degrees. The higher cathodic point corresponds with the separation of sodium and the lower with the separation of hydrogen. The highest anodic point the author believes is due to the discharge of hydroxyl ions, and the lower to that of O^2 ions. Polarization of fused lead chloride was determined by the decomposition method in glass vessels of various forms using carbon electrodes. Here also two breaks occurred, the position of the lower one varying greatly with the distance and size of the electrode.—*Journal of the Chemical Society* (London), March.

A Spanish Electric Power Transmission.

An interesting station has been built on the Jamara River, in Spain, utilizing a 3,000-horse-power waterfall, and also a producer-gas plant for the production of power to be transmitted to Madrid. The waterfall is sixty-seven feet high and has a flow of 325 cubic feet per second. The electrical installation consists of three generators giving three-phase current at 10,000 volts, with a fourth similar machine held in reserve, each unit being formed of a 750-horse-power turbine direct-coupled with an alternating-current machine of corresponding size. In addition there is a storage-battery plant of 2,000 ampere-hours capacity which works through a rotary converter, forward or backward, as the case may be, upon the circuit. In the city of Madrid there is a substation where the tension of the three-phase circuit is lowered from 10,000 to 3,575 volts, at which pressure it is distributed through the city. It is interesting to note that the prices charged for power are 0.20 peseta for lighting and 0.10 peseta for motive power, which are about one-fifth of the figures previously charged for current delivered from stations in the city of Madrid. These prices correspond with two cents and one cent American gold, respectively, and are, perhaps, the lowest charged for electrical energy anywhere on the Continent of Europe.—*Revista de Obras Publicas* (Madrid), April 3.

A Swiss Water-Power Plant.

An electrohydraulic plant of some special interest has just been completed at Vouvry, on Lake Geneva, by La Société de la Grande Eau. The turbines, of which at the present moment there are four of 500 horse-power installed, work under a head of no less than 3,150 feet. The principal conduit consists, in the first place, of a pipe 31½ inches in diameter, which is later subdivided into three of 19.7 inches as the pressure increases nearer the bottom of the fall. Each of these branches ends finally in two pipes, each 13.4 inches in diameter. For the laying of this conduit an aerial tramway was installed, having a length in plan of 5,609 feet, the rise in this distance being 2,985 feet. The pipes forming the conduit varied in length from 16.4 feet up to 26.25 feet, the heaviest weighing just one ton. The cable standards were built of timber, the longest span measuring 1,970 feet in plan. The cables used were of cast-steel wire, having a breaking strength of 220,000 pounds per square inch. They were 0.78 inch in diameter, their total strength being 20 tons. The factor of safety was accordingly only about 2½; but in view of the temporary character of the installations this was deemed quite sufficient by the contractors for the work. For working the line an electromotor of 20 horse-power was employed.—*Engineering* (London), April 11.

Hertz Waves and Certain Solar Phenomena.

In a note recently presented to the French Academy of Sciences, M. Charles Nordmann has set forth an interesting theory to account for the appearances observed in the corona of the sun and in comets. He recites recent experiments made upon Mount Blanc, looking to establishing the presence of electromagnetic radiations of the Hertzian variety in the sun's rays. The conclusion that he has arrived at is that these radiations are entirely absorbed in the upper layers of the earth's atmosphere. He considers that, if the electromagnetic theory of light is correct, the emission of electric waves by the sun is practically certain. Spectroscopic study of the sun has shown that the chromosphere is certainly the seat of electrical phenomena of great intensity and powerful discharges which are produced particularly in the region of sun-pots and faculæ, where through the influence of the violent movements of the solar atmosphere there must be separation of positive and negative electricity. This seems exceedingly reasonable, as solar winds with a velocity of 50,000 miles an hour have often been observed. In the discharges, perhaps somewhat comparable to terrestrial lightning, electrical waves must almost certainly be produced. From all these observations he is led to deduce a proposition to the effect that the solar surface emits electric waves, and that this emission is particularly intense from the regions where violent eruptions take place and at the time when these eruptions have a maximum intensity; that is, in the region of sun-spots, and at the time of maximum solar activity. From this proposition he draws a number of conclusions. For example, he considers the luminosity of the gaseous envelope of the sun, known as the corona, to be due wholly to the excitation produced by such waves, this being demonstrated by the observed conditions during various total eclipses since 1867. During a sun-spot maximum the distributed light of the corona is much more intense than during a minimum, while the contrary is true regarding the filaments, which are supposed to be composed of solid or liquid matter emitted from the solar surface and which attain a maximum during periods of small sun-spot activity. To explain this phenomenon, he calls into account the recently demonstrated pressure due to radiation, which he believes is sufficient to account for an action apparently in contravention to the general law of gravitation. Further very interesting speculations regarding the illumination of comets and the spectrum of these objects are also made, and a number of experiments made with attenuated gases in tubes subjected to electrical discharges are mentioned in this connection. The author concludes with the statement that these propositions up to a certain point have the character of hypotheses, but they are logically deduced from the electromagnetic theory of light and from the study of the sun's spectrum. They are not contradicted by any known fact, and they satisfactorily explain a number of observed phenomena hitherto inexplicable upon any other theory.—*L'Electricien* (Paris), April 12.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Motors for Driving Ventilating Fans and Blowers.

In the accompanying illustrations are shown a few of the applications of Lundell motors, manufactured by the Sprague Electric Company, New York city, to standard makes of ventilating fans and blowers. The types of motors generally used in connection with exhaust-fan outfits are wound as standard motors for 215, 230 and 500 volts, but they can be wound for special voltages and speeds, and are furnished with regular rheostats when this is desired.

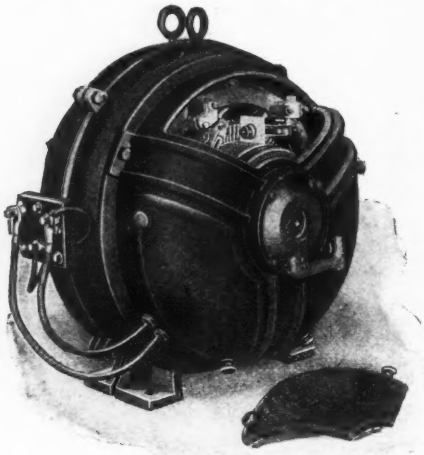


FIG. 1.—SLOW-SPEED SIX-POLE MOTOR, WITH ONE COVER OFF.

Fig. 1 shows a multipolar slow-speed motor, of the six-pole single field-coil type, with the usual self-oiling and self-aligning ring bearings. In this type the bearings are supported by brackets secured to the field frame of the motor. The bracket consists of three arms between which can be placed enclosing covers for the purpose of making the motor entirely enclosed.

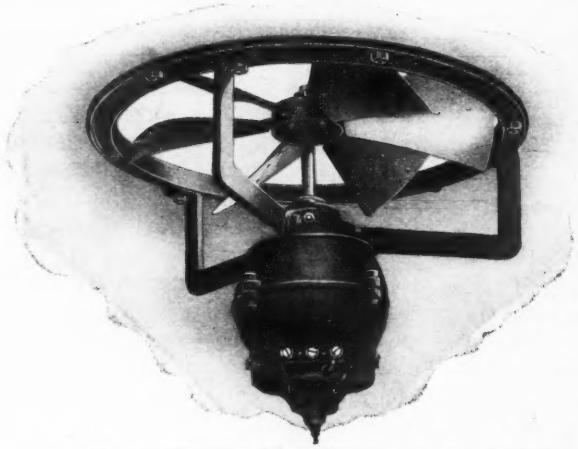


FIG. 3.—SHOWING SMALL MOTOR, ON VERTICAL FAN.

The field frame consists of two symmetrical divisions, each containing half the yoke and three pole-pieces in one casting. The field coil, which is form wound, is enclosed within the yoke which constitutes the external frame of the motor and entirely protects the coil.

The armature cores are laminated and of the slotted drum type, with form-wound coils rigidly secured in the slots.

The commutator is solid and is well insulated with the best grade of mica. Radial carbon brushes are employed, and a hand-wheel is provided for the movement of the rocker arm when changing the location of the brushes on the commutator. The commutator brushes are accessible by side doors which may be left open or closed, as occasion may require.

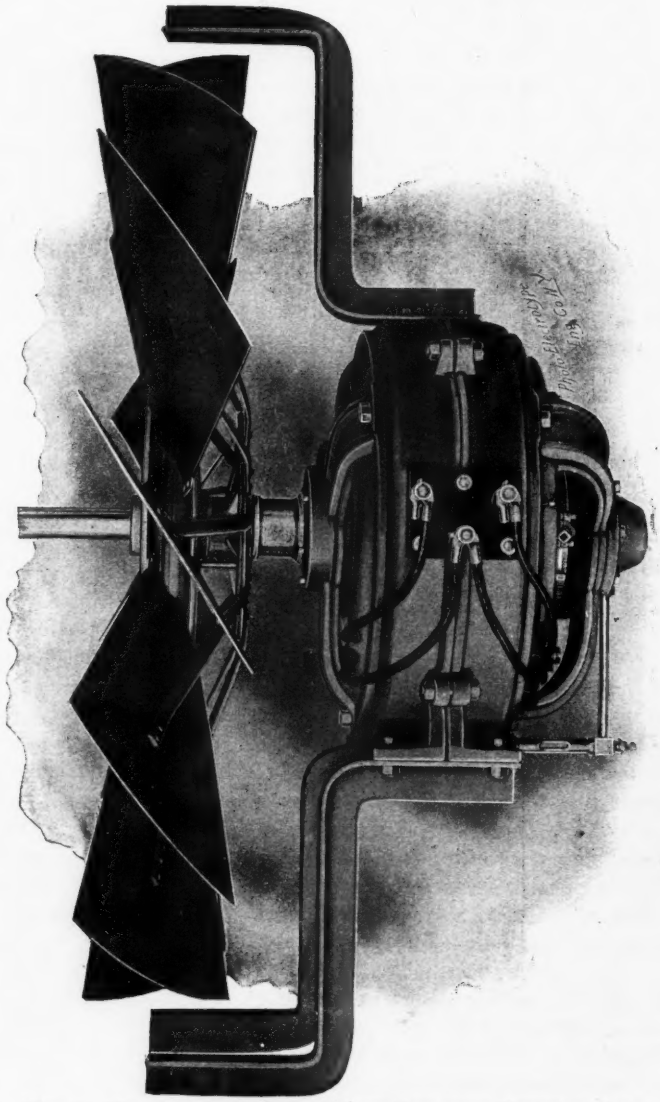


FIG. 2.—MOTOR CONNECTED TO 60-INCH FAN, WITH VERTICAL FAN.

These motors are well adapted for direct connection to ventilating fans and blowers and can be shunt, series or compound wound, and wound for various speeds and voltages other than standard. Fig. 2 shows the motor direct-connected to a sixty-inch fan with a vertical shaft. Fig. 4 shows a positive pressure-blower direct-connected with a Lundell motor, Fig. 3 showing a smaller motor direct-connected with a vertical fan. In Fig. 5

is shown a motor direct-connected with a blower for forge work, and Fig. 6, a small motor with a four-bladed fan, shows a convenient application of the work of ventilating. The motor is mounted by means of brackets so that the blades revolve in the opening. This opening may be made by having a board cut to fit the top or bottom of a window opening. A small wall switch is furnished with which the speed can be suitably controlled from any desired position.

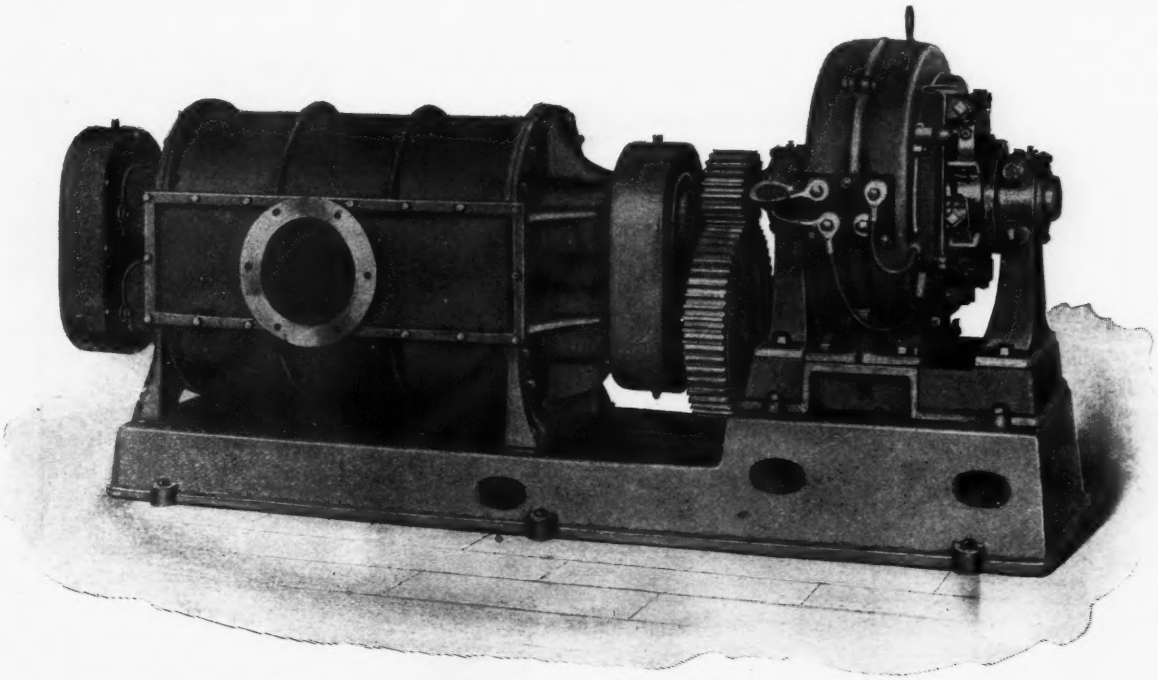


FIG. 4.—MOTOR DIRECT-COUPLED WITH POSITIVE PRESSURE BLOWER.

FIG. 5.—MOTOR CONNECTED WITH FORGE.

A small percentage of aluminum added to babbitt is said to result in a metal very much superior over the ordinary babbitt material, seeming to increase the durability and wearing properties. Dovetailing the babbitt in strips is recommended for the reason that it gives equal bearing all over the surface and it is stated that another advantage of this material is its extreme malleability, as it may be hammered out to a thin edge without cracking, whereas the ordinary babbitt is not at all or only slightly malleable. An advantage of using this material for bearings is said to be that it can be rolled into shape for inserting in dovetailed recesses and the recesses can be cast and drifted out at a very small expense and without waste of babbitt.

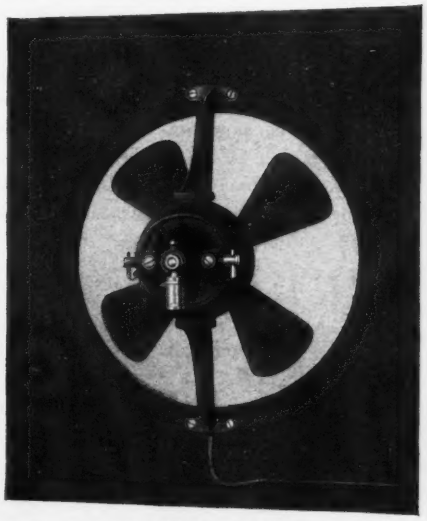
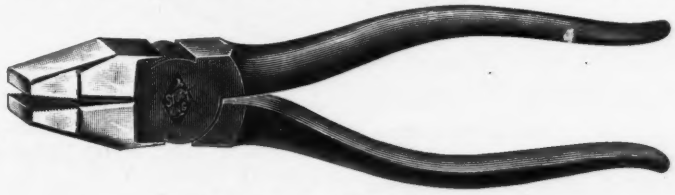


FIG. 6.—SMALL MOTOR FOR VENTILATING.

Linemen's Side-Cutting Pliers.

In the accompanying illustration is shown a new drop-forged steel side-cutting pliers, which has recently been put upon the market by Miller, Sears & Walling Company, New York city. The manufacturer calls these the "Storm King," and claims that they embody all desirable features, while such features as experience has shown to be objectionable are eliminated.

The shape of the handles and their relation to the jaws ensure the greatest effectiveness in cutting, and it appears to be the testimony of linemen and electricians who have used this tool that it fits the hand with great comfort to the user. The cutters, which are raised, are finely tempered, with side bevels and rounded edges, and are highly polished, making them attractive in appearance.



LINEMAN'S SIDE-CUTTING PLIERS.

An All-Wire Rail Bond.

In railway equipment specifications too much care can not be given to the proper selection of bonding material. The accompanying illustrations give a very good idea of the all-wire rail bond manufactured by the Ohio Brass Company, of Mansfield, Ohio. The bond which is shown in Fig. 1 is made entirely from one piece of flexible copper cable. The conducting strands and terminals are made from a single piece of cable, and there are no cast or welded joints in the bond to become loose or interpose additional internal resistance due to imperfectly cast or welded joints. The conductivity of this all-wire bond is given as that of commercially pure copper, and it is claimed that this conductivity is maintained throughout the entire length, including the terminals. This bond is intended for use under the fish-plate in which position it is protected from injury from outside sources as well as from theft, and a variety of such styles is manufactured. It may also be used around the fish-plate or under the base of the rail. Special types of bonds for these purposes, as well as for close connecting and underground bonding, are furnished.

The bond is applied by means of a compressor designed to ensure a perfect contact between the terminals of the bond and the rail ends, being so shaped that a large contact surface is presented to the rail, a contact of extremely low resistance being secured. The bond is made of very flexible standard cable and can successfully withstand the jar and vibration of the rails as well as expansion and contraction.

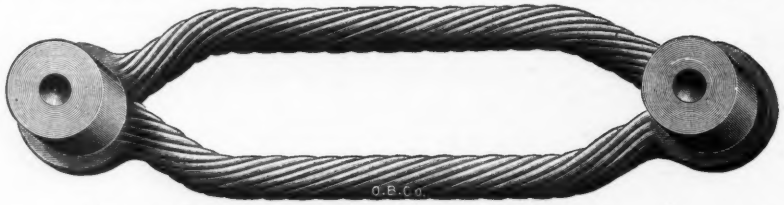


Fig. 1.—All-Wire Rail Bond, Cut from Copper Cable.

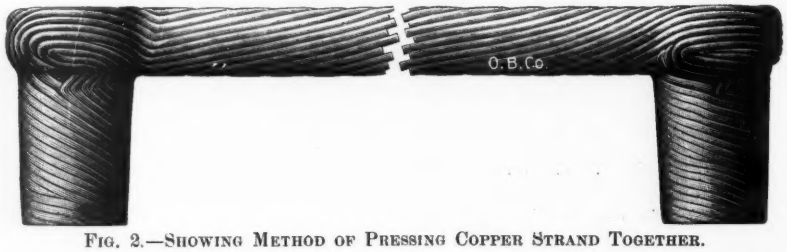


Fig. 2.—Showing Method of Pressing Copper Strand Together.

The copper cable is cut to length and placed in a forming machine in which the ends of the cable are cold-pressed into shape, as is shown in Fig. 2, the size of the terminals, however, being considerably larger than in the finished bond. The ends are then heated almost to the melting point and forged accurately to size in a steel die. The size of the terminals is thus reduced, the strands of wire composing them being perfectly welded together, forming a solid mass of copper. Fig. 3 shows the appearance of the finished bond and illustrates the manner in which the strands of cable are gradually merged into the solid copper terminals.

Fig. 3.—Finished Bond Showing Terminal Head.

The "Perfection" Rail Bond.

In laying down the track equipment of an electrically driven railway a particularly essential feature, in order that the carrying conductor shall give the highest efficiency, is the subject of rail bonding. Close contacts and very low resistances are absolutely necessary, while rapid and positive application of the rail bond to the rail is a necessary part of successful construction work.

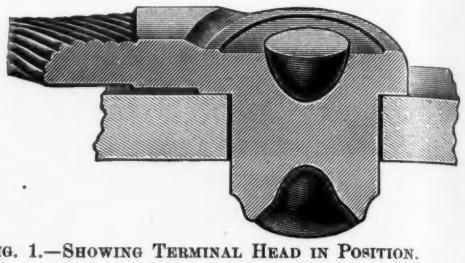


Fig. 1.—Showing Terminal Head in Position.

In the accompanying illustrations are shown the types of rail bonds and the method of applying such to the working rail, as are manufactured by the "Perfection" Rail Bond Company, Chicago, Ill.

The bond terminals of the "Perfection" rail bond are expanded by the use of special non-corrosive bronze plugs which are as hard as steel. The metal used for the purpose of expansion being the same character as the bond itself, the tendency to electrolytic action is minimized and a bond of lasting qualities is assured. The principal is, that the terminal must be expanded from its centre outward toward its surface and the pressure being uniform throughout the entire length of the hole.

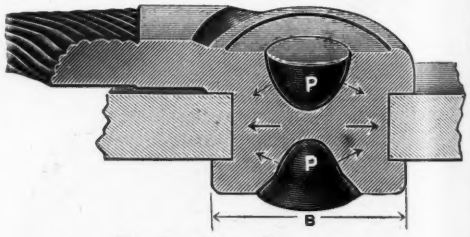


Fig. 2.—After Pressing.

Referring to the illustrations Fig. 1 shows the bond placed in the rail ready for pressure. Into each terminal are the two hardened bronze plugs, one, on the underside of the terminal being provided with a flange, which when the plug is pressed home turns over the protruding end of the terminal forming a perfect rivet-head, as is shown in Fig. 2. After the bond is placed in the hole in the rail the two plugs are pressed toward each other, preferably by a hand compressor of convenient size, and as these plugs are pressed toward each other the copper in the web intervening between the plugs is

forced out laterally toward the wall of the hole in the rail enlarging the diameter of the bond terminal and turning back the bottom portion of the lower or inner side of the rail.

It is stated by the maker that after the plugs have been forced into the copper

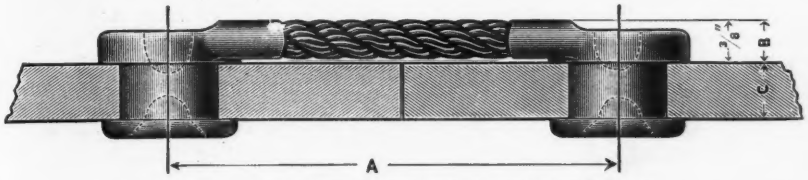
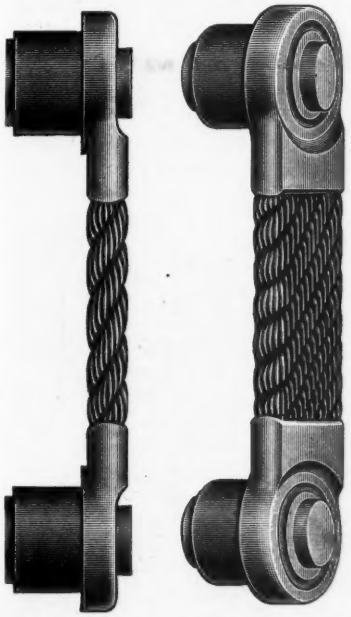


FIG. 3.—SHOWING COMPLETED SECTION OF RAIL BONDING.

terminal of the bond they become so thoroughly a part of the bond as to be practically homogeneous with it and it is impossible to remove them without destroying the bond itself.

The particular features advanced by the manufacturer of this rail bond is that the electrical and mechanical contact is excellent and the resistance is practically nothing. The pressure required to press home the plugs is very small, in most in-



FIGS. 4 AND 5.—TYPES OF IMPROVED RAIL BOND.

stances it being possible to use an automatic compressor furnished by the company. Where it is not possible to use this special tool the nature of the bond and plugs in the terminal is such that a limited amount of hand labor only is necessary to perform the work.

The connections between the terminals are made bv flexible copper cables designed to meet the requirements of strength, elasticity and carrying capacity. F. B. Badt & Company, Monadnock Block, Chicago, is the general sales agent for this rail bond.

Water and Gas-Proof Subdivided Electrical Conduits.

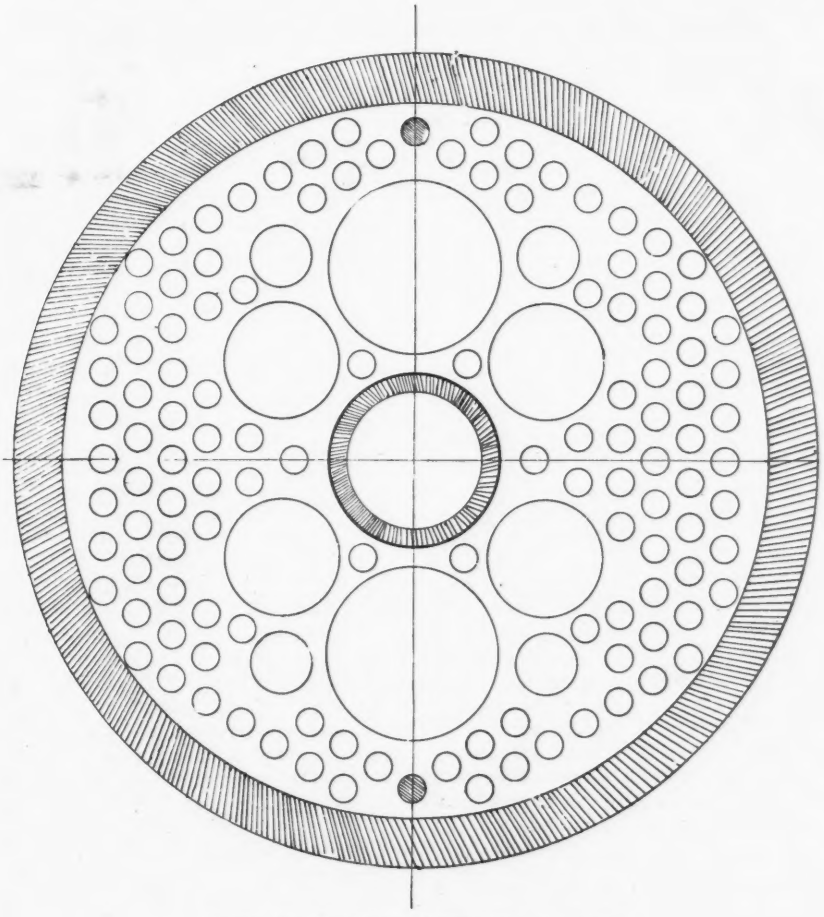
The use of underground systems for the conveying of cables and wires carrying electric current from point to point is growing with great rapidity. The popular agitation is developing in extent, and it is becoming necessary, in order to satisfy public sentiment, to eliminate current-carrying apparatus from all exposed places within a city.

In the water and gas-proof system of subdivided conduit, manufactured by George F. Averill, it is claimed that a very great convenience in laying the conduit and subsequently drawing the cable is secured.

The duct, as planned by the manufacturer, can be used to carry, in combination, telephone cables, electric light wires, trolley feeder wires and telegraph wires. Referring to the illustration the duct is subdivided into small orifices or tubes of four dimensions. The smallest is intended for the use of telegraph wires, the next larger for trolley feeder wires, the ones next larger to these for electric light wires, while the largest is intended for telephone cables. The duct is also claimed to possess a peculiar advantage in that it has a flange on the outside and is provided with dowels, situated diametrically opposite to each other, which make an easy and rapid alignment.

It is claimed that in the electric light field it is possible to draw in and handle single wires containing any potential of current or a multiple of wires making any size cable desired. For telephone purposes it is designed to secure a moisture-proof insulation, and which, it is claimed, will effectually protect it from interference for any surrounding wires, no matter how close the proximity of the same.

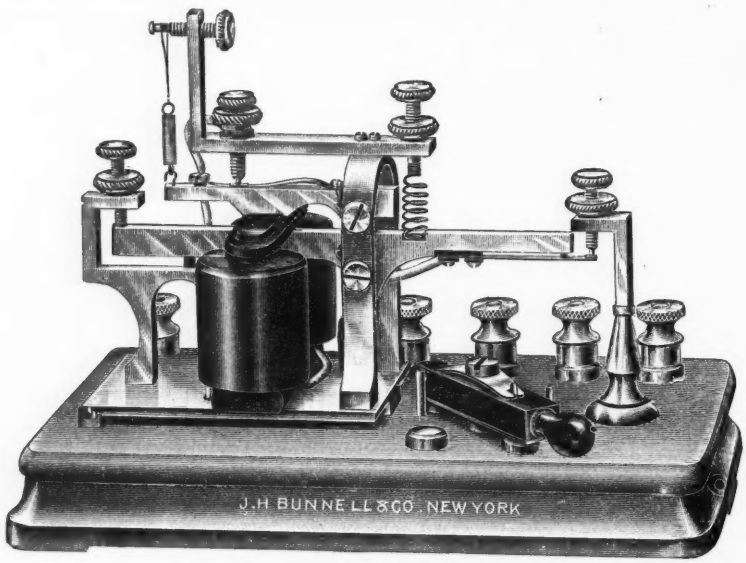
With moisture-proof manholes arranged at any distance apart suboutlets may be arranged so as to establish tele-



WATER AND GAS-PROOF SUBDIVIDED CONDUITS.

graphic points in the manholes for communicating purposes in case of wreck or any necessity that may arise.

The manufacturer claims that by means of this system a complete installation of underground distribution can be established, comprehending the entire field of electrical energy in a single subdivided duct and at the same time provide a lasting and thoroughly effectual working conduit.



New Automatic Repeating Transmitter.

An Automatic Telegraph Repeater.

In the accompanying illustration is shown a new automatic repeater apparatus for telegraphic work which comprises two standard relays and two Ghegan transmitters, this constituting a complete set of automatic repeaters.

In Fig. 1 it will be noticed that besides its ordinary armature, with a spring contact, the transmitter is provided with a second armature mounted above the regular one. The lever of this second or superposed armature also carries a spring contact so arranged that it makes contact with its back stop the instant that the armature begins its upward movement, and does not break contact therefrom until its downward stroke is almost completed, so that with two circuits connected to the contacts of the transmitter armatures, one of the circuits so connected is always closed before the other is opened, by the movements of the armatures.

The second armature is adjusted so that on closing the local circuit of the transmitter the regular armature must reach its front stop before the magnetism induced in it is sufficiently strong to draw the second armature from its back stop, the object of this being to allow a sufficient margin of time between the closing of the main circuit by the downward movement of the first armature and the opening of the shunt circuit by the subsequent downward movement of the second armature to permit a relay in the main circuit to close its local contacts before the shunt circuit around them is opened.

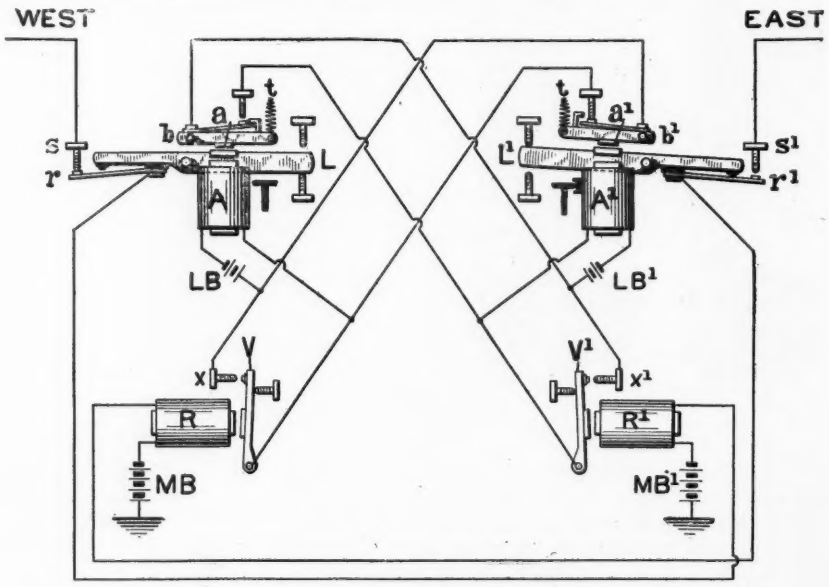
In Fig. 2 is shown how the main, local and shunt circuits are to be connected.

When a key on the western circuit is opened the instruments assume the positions shown in the diagram. The armature of relay R^1 first falls back and opens the local circuit of transmitter T^1, which, in turn, opens the eastern circuit at s^1 r^1, thus causing the armature of relay R to fall back. This falling back of the armature of relay R, however, does not affect the local circuit of transmitter T, because before the eastern circuit was broken at s^1 r^1, the shunt around the local contacts of relay R was closed at a^1.

On closing the western key, the armature of relay R^1 closes the local circuit of transmitter T^1, which, in turn, first closes the eastern circuit at s^1 r^1, and, as already explained, after sufficient time has elapsed to permit the armature of relay R to reach its front stop, opens the shunt circuit of transmitter T at a.

Should east "break" when west is sending, the armature of relay R would remain on its back stop, thus breaking the local circuit of transmitter T, on the first downward stroke of the superposed armature of transmitter T^1, and so break the western circuit at s^1 r^1.

These repeaters have been in use on the Pennsylvania Railroad for some time and it is claimed that they have given perfect satisfaction. The manufacturer, J. H. Bunnell & Company, Incorporated, 20 Park Place, New York city, claims that when once set the apparatus needs practically no attention, the only adjustment necessary being that of the ordinary relay.



Plan of Connection for Automatic Repeater.

Extension of Rapid Telegraphy.

The Delany rapid telegraph system, which has been in regular operation by the Pennsylvania Railroad between Philadelphia and Altoona for the past six months, is to be immediately extended to Harrisburg and Pittsburg. The new apparatus was ordered some time ago and is ready to be installed as soon as the Pittsburg station is ready.

About 500 messages, equivalent to 1,000 ordinary commercial messages, are sent daily by the Delany method over the Philadelphia-Altoona wire, which includes a telephone circuit in constant use without the least interfering with conversation.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

AN INTERESTING INDEPENDENT TELEPHONE MOVEMENT—A trust deed covering $50,000,000, in bonds of the Interstate Independent Telephone and Telegraph Company, has been filed in Chicago and it is rumored that this is the first step toward consolidating the independent concerns of the Middle West and eventually obtaining an entrance into Chicago. At present the Interstate company has control of only one system, that built by the Northwestern Telephone Company of Illinois, maintaining lines in and between Aurora, Joliet and Elgin and the country region of Kane and Will counties. It also has franchises in Peoria and Springfield. Negotiations are said to be under way for a chain of connected systems as far West as the heart of Iowa and perhaps to St. Louis. The officers of the new company are: Henry E. Evans, Aurora, president; Frank W. Tracy, Springfield, vice-president; Archie B. Conklin, Aurora, treasurer; Edward R. Conklin, Aurora, secretary.

THE LONDON UNDERGROUND SYSTEM—A statement has been made recently concerning the purchase of the underground electric railway company, of London, by an American syndicate, Speyer & Company. It appears that Speyer Brothers, of London, Speyer & Company, of New York, and the Old Colony Trust Company, of Boston, have formed a syndicate for $25,000,000 to take the shares of the underground Electric Railway Company, of London, Limited, which has been incorporated in London. The objects of the new company are to include the acquisition and working in whole or in part of the future undertaking contract by the Metropolitan District Electric Traction Company, Limited, of London, *viz.*, the Baker Street & Waterloo Railway Company, the Brompton & Piccadilly Circus Railway Company, the Great Northern & Strand Railway Company, and Charing Cross, Euston & Hampstead Railway Companies, as well as an agreement in connection with electrification of the Metropolitan District Railway and also general powers to carry out similar works. The stockholders of the Metropolitan District Electric Traction Company will take shares in the new company for their holdings. It is intended that Charles T. Yerkes shall be one of the directors of the new company and the first chairman of the board of directors. The arrangement of the syndicate will be in the hands of the above named firms and it is stated that about one-half of the syndicate has been subscribed for in London and one-half in New York and Boston.

ELECTRIC POWER FOR SWISS RAILWAYS—The fact that Switzerland is dependent on foreign countries for all the coal that is consumed there, being barren as far as coal production is concerned, has drawn attention to the great unemployed water power and has given rise to many propositions tending to promote the country's independence in traffic and industry. The idea is not a new one by any means, but until recently it has not received conclusive expert investigation. An interesting study has been published by L. Thorman, an engineer of Zurich, on the basis of substituting electricity for steam on the Swiss railways. While it is possible to raise sufficient water power to operate all the Swiss railways, engineer Thorman proves that it is a mistake to believe that the expense of traffic would be very greatly decreased. The cost of transformation and reconstruction would be heavy. The five principal Swiss railway lines demand about 30,000 horse-power per day. To guarantee this 60,000 horse-power of high-tension alternating electric current would be required and to this it would be necessary to add a sufficient reserve. Without taking into consideration the powerful waterfalls which exist the statistics of works, which are either in the course of construction or designed, give a total of 86,000 horse-power which would be more than sufficient for the railways under consideration and allow a surplus to be used for industrial purposes. In calculating the cost of the establishment the entire amount necessary would be some $31,000,000. While the direct saving would not be important, the country would profit enormously as the vast amount expended for coal would remain in the country and the general utilization of water power would also mean a valuable encouragement for other industries. The Maschinenfabric Oerlikon has made an application to the Federal government for a concession to establish a line of twenty kilometres (twelve and four-tenths miles), of electric standard gauge railway for experimental purposes, and it is quite probable that this concession will be granted.

SPECIFICATION FOR THE FURNISHING AND INSTALLING OF WIRELESS TELEGRAPHY SYSTEMS IN ALASKA—The specifications for the installing of wireless telegraph systems in Alaska, as issued by the War Department Signal Office, contemplate four routes: One between Fort Davis, Nome City and some point on Stuart Island—a distance of approximately ninety miles; or preferably between Nome City and Fort St. Michael's Island, approximately 108 nautical miles. Another route is between Rampart and Winter Houses, on the Tanana River, to some other suitable and convenient place near the mouth of the Delta River, approximately 136 nautical miles. The fourth route is preferable between Fort Gibbon and a point on the Tanana River, at or near the mouth of the Delta River, and Bates Rapids, which can be reached by boat. The approximate distance between Fort Gibbon and the mouth of the Delta River is 165 nautical miles. The two latter routes are to be operated either directly or with intervening relays, at the option of the bidder; but a definite decision in regard thereto must be made in the proposal. Special instructions to bidders as to routes, the speed, and reckoning are made, and the proposals must specify a definite date upon which each route will be completely equipped and ready for the working test and inspection by the Signal Corps. It is stated that it is desired that the two routes first mentioned should be completely equipped, if possible, on or before September 1, and that the two routes last described be ready on October 1, 1902, respectively. Before the contract is awarded, bidders must be prepared to demonstrate their ability to transmit legible records for two consecutive days for a distance of sixty miles, at any point on the Atlantic seacoast which may be selected, and the demonstration shall be made at their expense, and to the satisfaction of the Board of Officers of the Signal Corps of the United States Army. Each separate system must work satisfactorily for not less than ten consecutive days or more than twenty consecutive days, at the option of the United States, and must be thoroughly equipped before acceptance by the Signal Corps. The successful bidder will be required to give bond in the sum of fifty per cent of the total amount of contract for the faithful performance of the stipulations of the contract; and the Signal Corps reserves the right to accept or reject the conditions and to name a penalty which shall be agreeable to the successful bidder.

AUTOMOBILE NOTES

AUTOMOBILE STATION IN BUFFALO—The Buffalo Automobile Station Company has established a station in West Utica street where automobiles will be charged and cared for by experienced electricians, and to which is connected a complete repair shop under the supervision of experts. Automobiles will also be called for and delivered to owners at their residences.

THE AMERICAN AUTOMOBILE ASSOCIATION, which assembled in convention in Chicago on March 3, is sending a circular letter to all the automobile clubs in the United States which have not yet joined the association. A cordial invitation is extended to these to become members of the American Automobile Association. The general purpose of the organization is to secure rational legislature, to form proper rules governing the use of the automobile, to protect the interests of automobilists against unjust discrimination and to maintain their legal rights and privileges, to encourage the use of the automobile and its development and to promote the good roads movement. The letter states that the individual clubs are doing good work in the local field and that an excellent opportunity exists for the individual clubs to unite in the national organization. There is great need of cooperation and assistance and the association trusts that it may meet with an early response to the invitation. The officers are Anthony E. Scarritt, of the Automobile Club of America, president; F. C. Donald, of the Chicago Automobile Club, N. W. Grant, of the Long Island Automobile Club, and H. G. Morris, of the Automobile Club, of Philadelphia, first, second and third vice-presidents. Jefferson Seligman, of the Automobile Club of America, and S. M. Butler, of the Automobile Club of America, are respectively treasurer and secretary.

TELEPHONE AND TELEGRAPH

SHELBY, IOWA—The Shelby Independent Telephone Company is erecting its new lines, and the system will soon be in operation. Lines extend to all neighboring towns.

MOLINE, ILL.—The Union Electric Telephone Company has commenced work on the tunnels for the reception of cables, and construction and installing will be moved forward very rapidly.

PETERSBURG, VA.—The Mutual Telephone Company of this city has completed a line between Petersburg and Prince George Court House, and communication is now established between these places.

CUMBERLAND, MD.—The city council of Cumberland at a special session passed the ordinance granting a franchise to the Western Maryland Telephone Company to establish an independent system in Cumberland.

OSHKOSH, WIS.—Application has been filed by the Oshkosh Telephone Company asking for a franchise for an independent telephone line in this city. An underground system is to be used. A. B. Ferdinand, of Milwaukee, is the promoter and Jay A. Hinman, of Oshkosh, is the local man chiefly interested.

POTTSVILLE, PA.—The Lykens Valley Telephone Company has been absorbed by the United Telephone Company. The Lykens Telephone Company's line covers Dauphin and parts of Lebanon, Northumberland and Schuylkill counties, the terminus in Schuylkill being at Tremont, where the line connects with the Pennsylvania Telephone Company's line.

DECKERSTOWN, N. J.—Matters of organization for the Farmers' Telephone Company are progressing, and subscriptions are being pledged for the project. The promoters believe that a good system will be completed early in the summer. An effort will be made to reach every house that is possible. From present indications it is believed that the first points to be covered will be Sussex and Port Jervis.

BOULDER, COL.—The city council has been asked by James D. Garigues, of Greeley, to defer action on a proposed telephone franchise asked for by Greeley parties as a part of the Greeley Independent Telephone System. It has purchased the franchise of the Boulder Railway and Utility Company. The council declared that the latter had only a street railway franchise and served notice on Garigues *et al* that they must not erect poles in this city.

BUFFALO, N. Y.—Superintendent W. H. Johnston, of the Frontier Telephone Company, said this afternoon that the plans of the company for the system of underground conduits to be constructed in this city are now complete and ready for submission to Commissioner of Public Works Ward and Deputy Commissioner Morse, who has charge of the city engineering department. As soon as the approval of the city officials is secured to the plans, the company will pay $15,000 to the city, as required by its franchise, and then the work of constructing the conduits will be begun.

ELECTRIC RAILWAYS

MORRIS, N. Y.—The Oneonta & Richfield Springs Electric Railway Company has voted to increase its capital stock from $1,000,000 to $1,500,000.

WILMINGTON, N. C.—It is quite probable that the Wilmington Seacoast Railroad may be converted into a trolley line early in June. Owing to the lateness of the season, however, the railroad company is hesitating about the advisability of undertaking the enterprise until next fall.

BERKELEY, CAL.—The board of town trustees has granted franchises for the extension of the Oakland Transit Company's lines in Berkeley. The company is to pay $1,000 bonus and two per cent of the gross receipts after the first five years of operation to the Berkeley municipality.

HANCOCK, MICH.—The matter of the extension of the Houghton County Street Railway to Lake Linden is now in a fair way to be settled. The citizens of Lake Linden are anxious for a street railway service to Hancock and Calumet, and it is probable that the new agreement which the trolley company is about to issue will make the building of the system feasible.

MEMPHIS, TENN.—Application has been made for a charter to incorporate the Shilo Battlefield & Interurban Electric Railway Company, of Saltillo, Tenn. An electric car belt route has started at Jackson, Tenn., passing through Saltillo, Adamsville, Shilo National Park and on to Corinth, Miss. The incorporators are: W. F. Hinkle, J. H. Craven and J. S. Barham, all of Saltillo.

CLEVELAND, OHIO—Authority has been petitioned for the receiver of the Lake Shore Electric Railway Company to issue $300,000 in receiver's certificates to complete the new section of the road, supply the cars needed, and operate the line through from Cleveland to Toledo. The system is made up of the Cleveland & Lorain, Sandusky & Interurban, Sandusky, Norwalk & Southern, and Toledo, Freemont & Norwalk lines.

TRENTON, N. J.—The American Elevated Railway Company, which has recently increased its capital from $5,000,000 to $10,000,000, contemplates the building of an elevated electric railway between New York and Philadelphia. It is stated that one of the purposes of the company is to run express trains between these two points at a very high rate of speed, which would make the running time between New York and Philadelphia very much shortened.

BOSTON, MASS.—It has developed that a plan is under consideration of leasing the Webster & Worcester Street Railway Company's property to the Webster & Dudley Street Railway Company and to combine these two Massachusetts roads with the Webster & Connecticut Eastern Street Railway Company of Connecticut, and make them a part of a great scheme of railways in the central southern part of Massachusetts and the northern section of Connecticut. A direct route from Worcester to Norwich is now completed to within twenty-five miles of Norwich, while the building of other lines is contemplated.

NEW INCORPORATIONS

AUSTIN, TEX.—The Roberts Telephone and Electric Company. $50,000.

HARRISBURG, PA.—The Swiftwater Water and Power Company. $1,000.

BIRMINGHAM, ALA.—The Marion Electric Light and Power Company. $10,000.

CHICAGO, ILL.—Dix Telephone Company. $3,000. Incorporators: B. F. Holder, John C. New and A. Woodburn.

ALBANY, N. Y.—Auburn-Interurban Electric Railway Company. Capital increased from $250,000 to $1,000,000.

AUSTIN, TEX.—Orange Telephone Company, of Orange, Tex. Capital stock increased from $40,000 to $80,000.

HARRISBURG, PA.—Ironside Electric Light, Heat and Power Company, Bloomsburg; $45,000. Chartiers Telephone Company, McDonald, $1,000.

JERSEY CITY, N. J.—Wyoming Valley Telephone Company, Camden. $25,000. Incorporators: E. E. Pryor, Chas. F. Wagner and Philip Kingsland.

LYNCHBURG, VA.—Lynchburg Water Power Company. $100,000. Directors: R. D. Apperson, John D. Horseley, C. M. Blackford, D. C. Frost and R. C. Blackford.

INDIANAPOLIS, IND.—The Cumberland Telephone Company, Cumberland. $10,000. Incorporators: Joseph R. Ebaugh, William Gale, John H. Graff, Albert Ebaugh and others.

MINNEAPOLIS, MINN.—The Minnetonka Telephone Company. $50,000. Incorporators: A. B. Heslin, Park Rapids; W. U. Carroll, C. P. Wainman and D. F. Morgan, Minneapolis.

TRENTON, N. J.—The Union Railway, Power and Electric Company. $6,000,000. Incorporators: Nelson R. Vanderhoof, W. Mands Greene and Edward Cuddy, all of Jersey City.

JEFFERSON CITY, MO.—The United States Street Lighting Company, of Kansas City. $10,000. Incorporators: Edmund B. Ludwig, A. L. Harroun, W. E. Miner, W. H. Glaskin and Herbert A. Birmingham.

LEGAL NOTE

EJECTING PASSENGERS WHO REFUSE TO PAY THEIR FARES—In an action for damages against a railway company brought by administratrix, the trial justice charged the jury "that an individual within the car of a street surface railroad who refuses to pay his fare is a wrongdoer and has no legal right to remain in the car, and it is right he should be requested to leave the car when he has manifestly no right to remain." The court also charged that if a passenger refuses to leave the car "the conductor may then employ so much force as may be necessary in order to effect his removal, using no violence and committing no unnecessary injury;" but, however, declined to charge that "if the passenger refuses to comply and resists and an injury happens, it is an injury for which the company is not responsible, for it is a result attributable to his own wrongful conduct."

ELECTRICAL SECURITIES

Dealings have shown great activity during the week that compares to a marked degree with the conditions which prevailed during the period of speculative fever last spring. The past week has been a memorable one in Wall street for this year and the transactions have had an average considerably above a million per day. There is a very apparent evidence of greatly increased public sympathy with the market, and although the fine conditions prevailing are no doubt the result of manipulations by big operators and professional men, the interest which the outside public is now manifesting has considerable to do with the recent upward tendency. The Louisville & Nashville incident furnished the sensational feature of the week and it is probable that the control of so large a property has not before been turned over in such a short space of time. Practically all the southern transportation interests are now in reality as closely joined together by this policy as are the railroads of the Northwest, and in this connection there now arises another instance where the final decision in the pending Northern Securities case will be of grave importance.

The money market has shown decided improvement throughout the week, the last bank statement showing a good development. It is believed that there will be no further money stringency this spring. Sterling exchange holds steady and there is small prospect of gold exports. The large subscriptions to the $25,000,000 of the new issue of British Consols is not expected to cause gold shipments. The great success of that loan with over $2,500,000,000 subscribed when only $160,000,000 was offered indicates that there is plenty of capital seeking investment. A favorable effect has been produced on the foreign market on the strength of the London markets, owing to the possible successful outcome of the Boer peace negotiations.

Trade is reported as very active in nearly all quarters, railroad earnings continuing in good shape. The iron and steel trades are remarkably prosperous and the copper industry shows signs of decided improvement. Generally speaking, the commercial and industrial outlook remains prosperous.

ELECTRICAL SECURITIES FOR WEEK ENDING APRIL 19.

New York:	Closing.
Brooklyn R. T.	66½
Con. Gas	224⅜
Gen. Elec	323
Kings Co. Elec	196
Man. El	133⅞
Met. St. Ry	153
N. Y. & N. J. Tel. Co	169
Westinghouse Mfg. pf	226

Boston:	Closing.
Am. Telep. & Tel	178
Edison Elec	271
Mass. Elec. pf	97
New England Tel	149
Western Telephone & Telegraph	102

Massachusetts Electric led the Boston market in activity, nearly 10,000 shares changing hands on an average per day. New England Telephone reached 150, and Edison Electric Illuminating was up 2. A special meeting of the stockholders of the New England Telephone and Telegraph Company has been called for May 5 to act upon a recommendation of the directors to increase the capital stock of the company from $20,000,000 to $30,000,000.

Philadelphia:	Closing.
Elec. Co. of America	7¾
Elec. Stor. Bat. c	75¾
Elec. Stor. Bat. pf	75¾
Philadelphia Elec	5¾
Union Traction	44⅛
United G. I. Co	122

A noteworthy feature of the Philadelphia market was the resumption of the upward move in Electric Storage and the strength of the Electric Company of America and United Gas Improvement.

Chicago:	Closing.
Chicago Edison Light	175
Chicago Telep	175
Metropolitan El. pf	91
National Carbon	24½
National Carbon pf	87½
Union Traction	22
Union Traction pf	57

Small gains were made by the Metropolitan Elevated, Carbon, and Union Traction was traded into some extent. It has been rumored in Chicago that the Union Traction interests have taken over the stock held by Sutro Brothers and the Consolidated Traction Company, in order to end the litigation started by the Sutros to annul the agreement between the two companies.

PERSONAL MENTION

MR. GEO. T. MANSON, general superintendent of the Okonite Company, returned last week from a trip to New Orleans, San Francisco and the Middle West.

MR. EDWARD NEWMAN, president of the Newman-Spranley Company, New Orleans, La., has been in New York city this week, stopping at the Hotel Imperial.

MR. D. C. HEMINGRAY, secretary and treasurer of the Hemingray Glass Company, who has a wide acquaintance throughout the electric field, was a New York visitor last week.

COLONEL ALLAN C. BAKEWELL, general manager of the Sprague Electric Company, has recently been elected second vice-president of the Pennsylvania Society of New York.

MR. HERBERT B. MOSES, a recent graduate from Sheffield and Gottingen, has accepted a position as electrochemical engineer with the National Storage Battery Company at Buffalo.

MR. AND MRS. GEORGE WESTINGHOUSE this week entertained Lord and Lady Kelvin who remained with them in Washington several days. On Wednesday evening a reception was tendered to the distinguished visitors, at which the American Social Science Association were also guests.

E. J. HUNT resigned his position as manager of the Winsted Local Telephone Exchange, Winsted, Ct., to take effect on or about May 1. Mr. Hunt has been connected with the local exchange for more than a dozen years and has been manager with great success for the last four years.

MR. ADOLPHUS BUSCH has been elected president of the American Diesel Engine Company, of New York city. Colonel E. B. Meier has been elected vice-president of the same company. Mr. Busch is well known as the president of the Anheuser-Busch Brewing Company, of St. Louis.

MR. W. S. BARSTOW, a well-known mechanical and electrical engineer, who is at present building a power-house for the Long Island Railroad, has been appointed consulting engineer of the Hartford Carpet Corporation to build a power plant at the new factories this company is erecting at Thompsonville, Ct.

MR. JAMES A. BARKLEY, the electrical engineer for the Honolulu Rapid Transit and Land Company since June, 1900, has resigned this position to accept the position of assistant manager of the Cape Town Tramways Company, Cape Town, South Africa. Mr. Barkley sailed from Honolulu Hawaii, on February 26, 1902, for the United States and on April 9 sailed from New York for London, where he will receive his instructions, after which he will start for his new field of labor in South Africa.

THE FOLLOWING WELL-KNOWN GENTLEMEN were visitors to New York city last week: H. C. Thompson, the Electric Gas Lighting Company, of Boston; C. E. Trump, Novelty Electric Company, Philadelphia; T. H. Stewart, Electrical Supply Company, Philadelphia; H. C. Roberts, Electrical Supply Company, Philadelphia; Mr. Graham, of Washington; C. E. Brown, Central Electric Company, Chicago; T. W. Cushing, Illinois Electric Company, Chicago; W. W. Low, Electric Appliance Company, Chicago; W. P. Holmes, Chicago Edison Company, Chicago; Mr. Doubleday, Doubleday-Hill Electric Company, Pittsburg; C. B. Price, Pettingill-Andrews Company, Boston. Messrs. Sickiemeier and Franklin, of Chicago; Tremore, of Jacksonville, Fla., and Cohen, of Charlotte, N. C., were also in the city.

ELECTRIC LIGHTING

WARREN, OHIO—Warren councilmen have been making investigations as to the cost of building, equipping and running of municipal electric lighting plants. This matter has reached such a point that the question of bonding the town for $30,000 to $40,000 for this purpose is soon to be submitted to the voters.

ROCHESTER, N. Y.—The Rochester Gas and Electric Company has secured possession of the Manufacturers' Gas and Electric Company which was organized by Anthony N. Brady and Alden M. Young, of New York, and the Citizens' Light and Power Company has also passed into the hands of the Gas and Electric Company. The Citizens' property is to be bonded for $1,500,000 in forty-year four and one-quarter per cent bonds and the Gas and Electric Company guarantees the bonds which are a consideration for the sale. The Gas and Electric Company now owns about ninety per cent of the water rights in the city.

INDUSTRIAL ITEMS

H. H. FRANKLIN MANUFACTURING COMPANY, Syracuse, N. Y., announces that it has applied its finished casting process to a new line—to the making of miniature models for advertising purposes.

THE AJAX MOTOR VEHICLE COMPANY, New York city, describes and illustrates its product in a handsome pamphlet printed in two colors, which will be sent to any who are interested in electric automobiles.

WICKES BROTHERS, 95 and 97 Liberty street, New York city, have established a sales warehouse in Jersey City, where they will carry a full stock of new and second-hand boilers, engines, pumps, general machinery, wrought iron pipe, etc.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is ready to send 1902 fan motors for sample test. The company announces that hereafter electric desk and ceiling fans are first-class L. C. L. under the western classification, its efforts to have these reduced from double first-class L. C. L. having been successful.

MESSRS. MCKENNEY & WATERBURY, Boston, Mass., have secured contracts for electric fixtures for Fort Preble, Portland, Me., the Hotel Wentworth, Woodsville, N. H., the National Life Insurance Company Building, Boston, Mass., the Hospital Life Insurance Building, Boston, Mass., and several summer hotels and private houses in New England.

THE STANDARD POLE AND TIE COMPANY announces that on May 1 it will move into larger quarters as it has been very badly crowded for some time, owing to the volume of business which is being handled. It will have offices in the General Electric Building at 44 Broad street, New York city, and an invitation is extended for friends of the company to visit the new headquarters.

THE ELECTRIC LIGHTING OF PROCTOR'S THEATRE at Newark, N. J., is made the subject for the ornamentation of silver souvenir pin-trays, which are to be presented to the lady patrons at the matinees of Manager Proctor's theatres in Newark. There are myriads of electric lights on the front of Proctor's Newark theatre, and at night the illumination is one of great brilliance.

THE SPRAGUE ELECTRIC COMPANY has found it necessary to move its Boston office into new and larger quarters to handle the business in the New England district. It will now be located in the Weld Building, 176 Federal street. Mr. H. C. Farnsworth continues as manager of the Boston office. He has recently added to his staff Mr. George D. Simmons, who was formerly superintendent of the Hawks Electric Company.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., reports a very satisfactory increase in the demands for its crane motors and equipment. Several new sizes have been lately added to its line, which is now in such condition as to supply machines of from one to sixty horse-power. The various types are designed to fulfill the several requirements which call for trolley, bridge or hoist work. A large number of shipments have been made within the past few weeks.

THE WESTERN ELECTRIC COMPANY, Chicago and New York, has brought out a handsome fan-motor catalogue for 1902. This catalogue contains fifty-four pages and is splendidly printed on heavy white stock. Numerous half-tone illustrations add value to the work and the descriptions and tables of sizes and prices are very complete. The cover is a reproduction of a relief casting, and is further illuminated by a fine photographic representation of a W. E. four-blade desk fan.

THE AUTOMATIC SWITCH COMPANY, New York city, has announced that on the night of April 14 its offices and factory were extensively damaged by fire, the stock and machinery being injured to such an extent as to necessitate practically a new equipment of the main floor of the machine shop. Immediate steps have been taken to put the plant in running order, and it is expected that not more than a week will be necessary, and orders will be filled with the usual punctuality.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is often in receipt of commendatory letters from pleased patrons. An extract from a sample letter says: "We are pleased with the way you have filled our telegraphic order for A-B arc lamps. They reached us within twenty-one hours after the order was sent out, which is remarkable considering that we are nearly 300 miles from Chicago." This company keeps a large stock of these lamps in Chicago for immediate shipment.

THE MICA INSULATOR COMPANY, New York city, has recently perfected a new process for treating and refining linseed oil, whereby all deleterious matter is eliminated and the oil thoroughly oxidized in a direct manner, and without the aid of metallic oxides or any other objectionable chemicals. By the use of special machinery exclusively designed for this company this "Empire" oiled material may be secured in any length desired up to 500 yards. It is claimed that this material possesses the highest electrical insulating and mechanical qualities, and has an average large breakdown test of 600 volts per mil.

"THE FOUR-TRACK NEWS" for April, published by the passenger department of the New York Central & Hudson River Railroad, contains many interesting and instructive features. The reading of each article is short and pleasing and numerous illustrations add greatly in interest. Among the articles might be mentioned, "The Value of Travel," by L. K. Becker; "Trout Fishing in the Adirondacks," by Harry V. Radford; "Little Histories," by Bessie H. Dean, Jane Clark, J. Cleveland King, Anna S. Harlan, and Herbert Brooks. The frontispiece is a splendid engraving of Goat Island and the American Fall, Niagara. Another interesting engraving is a full-page group of prominent New York newspaper and railway men, taken at the Whirlpool Rapids, Niagara.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., is making one of its latest central energy multiple switchboards, consisting of six sections, with an ultimate capacity of 6,000 lines, for the Rawson Electric Company, of Albany, N. Y. Its present equipment consists of 2,100 lines, and included in this contract is one toll board consisting of two one-position sections and also all necessary power apparatus, arrester and distributing frames, relay racks, etc. Another contract with this company calls for the same type of switchboard, consisting of three sections with the ultimate capacity of 4,800 lines, and the necessary apparatus. A contract with the Rawson Electric Company, of Cohoes, N. Y., is for the same type of multiple switchboard of 2,400 lines capacity, with the necessary apparatus for complete operation included in the contract.

THE EDISON ELECTRIC ILLUMINATING COMPANY, Brooklyn, N. Y., is adopting a forceful means of bringing to the attention of possible patrons the advantages of an electric light installation in private residences. The following is one of a series of letters which the company is issuing—"The peculiar conveniences of electric lighting are very numerous; the following are but a few of them: No matches are needed. No necessity of reaching high chandeliers. Simply touch a button, in a convenient location, and the light responds. Switches can be arranged so that your rooms may be lighted before entering, and the light extinguished after leaving, thus having the light precede you in your movements through the house. Furthermore, electricity can be introduced in places where other illuminants are prohibited; for instance, lamps can be placed throughout clothes closets, in cosey corners, refrigerators, and other ordinarily dark places, which can be brilliantly illuminated whenever desired, with absolute safety. Many customers testify that this convenience alone is worth more than our entire lighting charges."

WESTINGHOUSE, CHURCH, KERR & COMPANY, New York city, secured two important contracts for electrical apparatus for operating railroad shops, including complete generating plants as well as motor equipments. The apparatus will be installed in the new shops of the Union Pacific Railroad Company at Omaha, which will contain two compound engines, directly coupled to 250-kilowatt, 250-volt engine-type generators, and one compound engine directly coupled to a 75-kilowatt, 250-volt generator. These engines are to run non-condensing under a boiler pressure of 150 pounds. The equipment includes twenty-one shop motors of various sizes, from five to twenty-five horse-power. Another installation will be that of the Oregon Short Line Railroad Company at Pocatella, Idaho, and will consist of Westinghouse machines throughout. It is proposed to adopt direct-driven tools wherever possible. Twelve motors, ranging from five horse-power to twenty-five horse-power, will also be used at the Pocatella shops, and there will be two standard engine-type outfits for direct connection to one 50-kilowatt, 250-volt generator, and one Junior engine for direct connection to 150-kilowatt, 250-volt generator. The plans for the installations provide for up-to-date shops in every particular.